MICROGATE

OPTOJUMP next

User Manual

Version 1.6

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1 INTRODUCTION

OptoJump Next is an innovative system of analysis and measurement that brings a new philosophy of performance assessment and optimization to the world of competitive sport. By acquiring the fundamental parameters that characterize the level of an individual's performance and physical condition, OptoJump Next allows coaches, trainers and researchers to constantly test and monitor their athletes. This makes it possible to ascertain the abilities or physical fitness of an athlete in a

simple and instantaneous way, creating even over a period of time a database that allows to compare values for that athlete or different athletes (even at a distance of months or years).

1.1 QUICK START: ONLINE VIDEO TUTORIAL

For a brief introduction to the software for OptoJump Next, we strongly recommend you watch the introductory webcast available on the official site:

http://www.optojump.com/support/software-tutorial.aspx

The software modules will be illustrated in about ten minutes. After watching it, you will be able to perform the most common operations, which can be summarized as follows:

- Graphic and surfing interface
- Checking of general parameters
- Checking of status of bars and webcams
- Insertion of athletes' data
- Performance of tests
- Viewing results
- Comparison of tests and statistics
- Printing and exporting of data to other programs

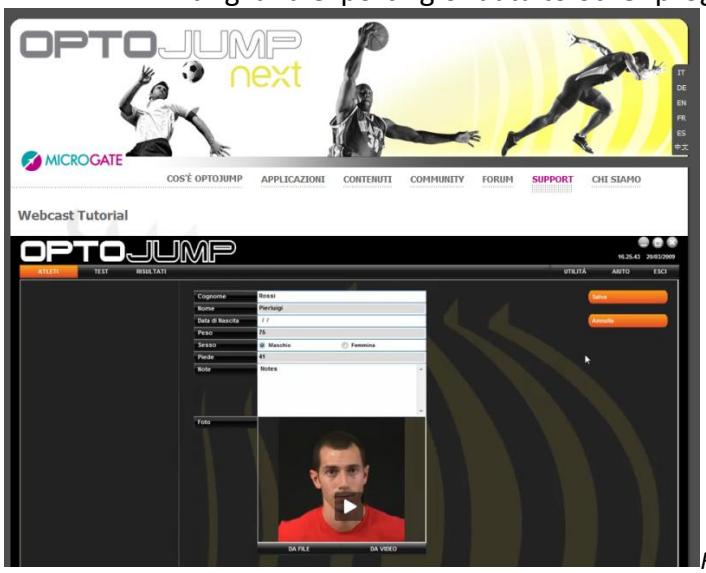


Figure 1 – Webcast Tutorial

2 SOFTWARE INSTALLATION

Start the OptojumpNext.exe setup program in the usual way for Windows.

In the first installation window the user is asked where to save the files for the installation of OptoJump Next. We advise you to leave the directory unchanged and to click on <Next> to continue.

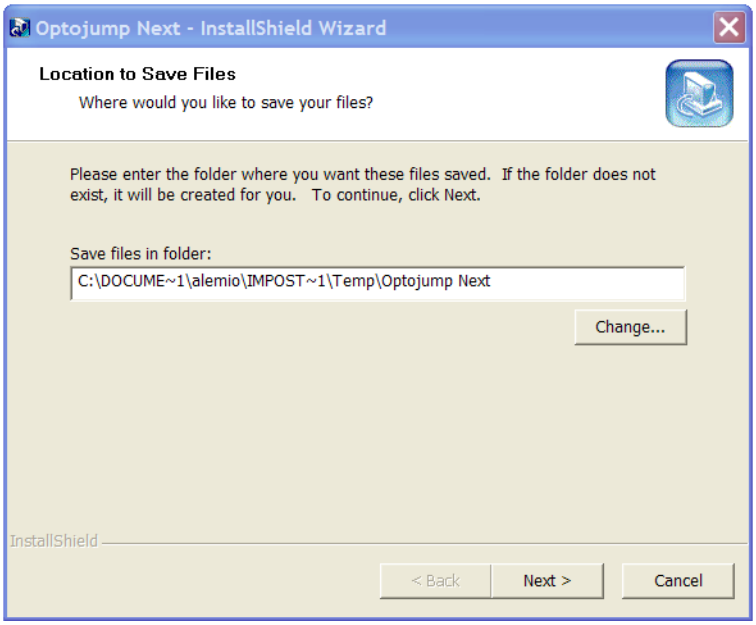

Optojump Next - InstallShield Wizard
Location to Save Files
Where would you like to save your files?
Please enter the folder where you want these files saved. If the folder does not exist, it will be created for you. To continue, click Next.
Save files in folder:
C:\DOCUME~1\alemio\IMPOST~1\Temp\Optojump Next
Change...
InstallShield
< Back
Next >
Cancel

Figure 2 – Installation wizard

In the first installation program window click on <Next>.

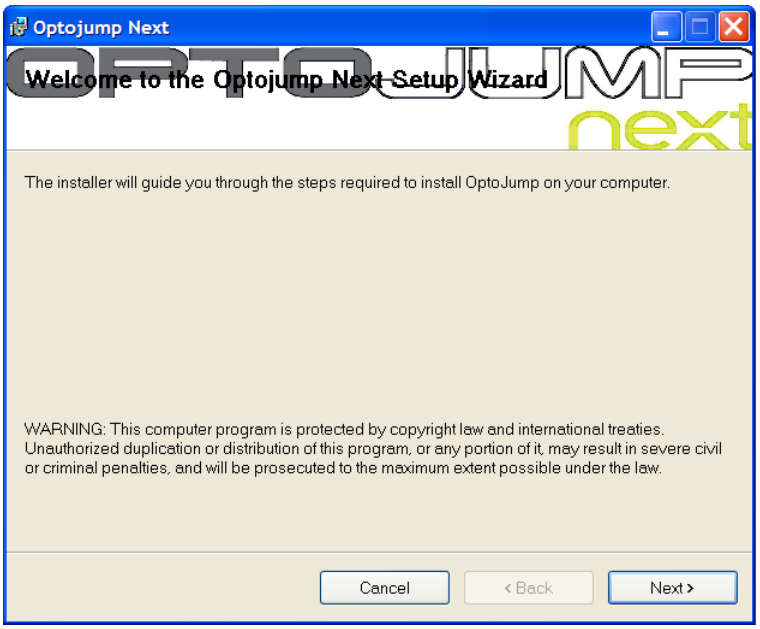

Optojump Next
Welcome to the Optojump Next Setup Wizard
The installer will guide you through the steps required to install OptoJump on your computer.
WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.
Cancel
< Back
Next >

Figure 3 – Installation - welcome.

In the next window you can insert a folder where the software will be installed.

If you want everyone with access to the computer to be able to use the product, select “Everyone”. Otherwise, select “Just me”.

We advise you to leave the folder unchanged and select “Everyone”. Click on <Next> to continue.

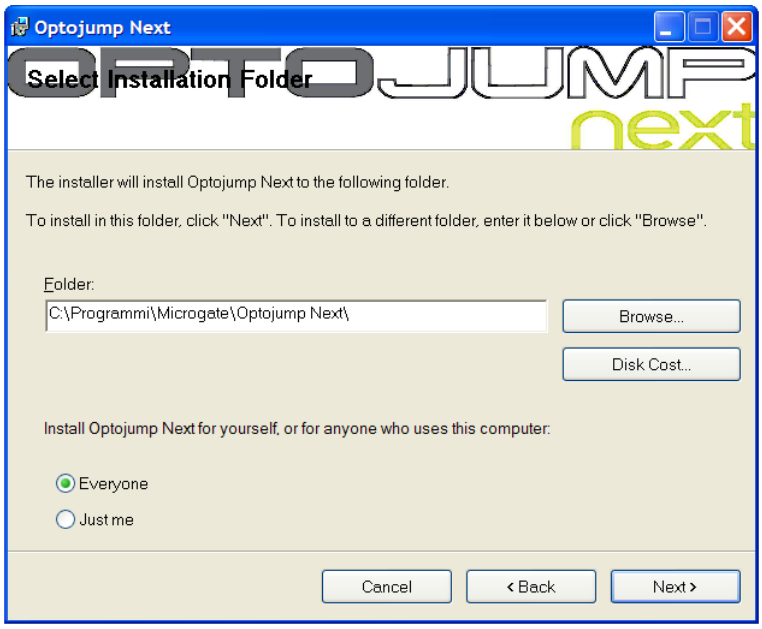

Optojump Next
Select Installation Folder
The installer will install Optojump Next to the following folder.
To install in this folder, click "Next". To install to a different folder, enter it below or click "Browse".
Folder:
C:\Programmi\Microgate\Optojump Next\
Browse...
Disk Cost...
Install Optojump Next for yourself, or for anyone who uses this computer:
Everyone
Just me
Cancel
< Back
Next >

Figure 4 – Installation – data insertion.

The next window offers to launch software installation. If all the data is correct, click on <Next>.

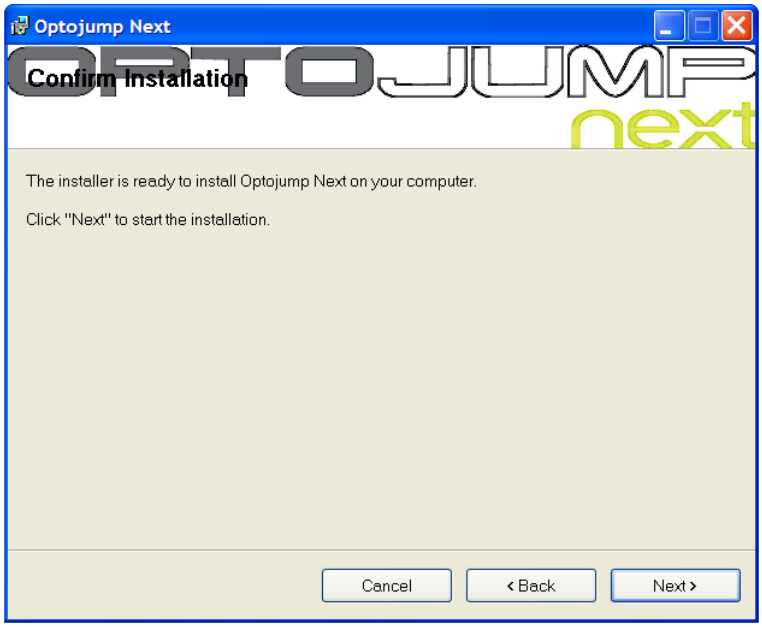

Optojump Next
Confirm Installation
The installer is ready to install Optojump Next on your computer.
Click "Next" to start the installation.
Cancel
< Back
Next >

Figure 5 – Installation – confirm installation

The setup program will install the product on the PC, showing state of progress.

During installation the OptoJump Next and Logitech webcam drivers will also be installed.

If for any reason this does not happen, please install the drivers separately. These are available on the Microgate USB key supplied with the hardware or on the site www.optojump.it in the Support section.

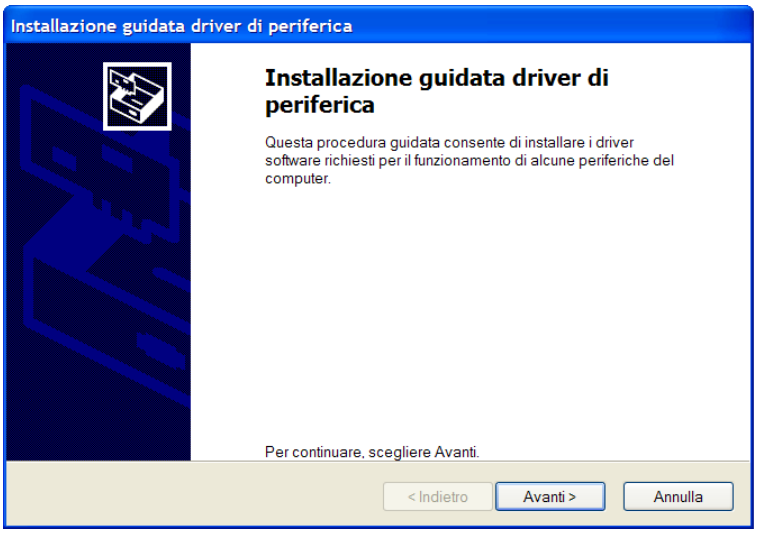

Installazione guidata driver di periferica
Installazione guidata driver di periferica
Questa procedura guidata consente di installare i driver software richiesti per il funzionamento di alcune periferiche del computer.
Per continuare, scegliere Avanti.
< Indietro
Avanti >
Annulla

Figure 6 – Driver Installation

Press <Next> to install the drivers and then <Finish> to complete installation.

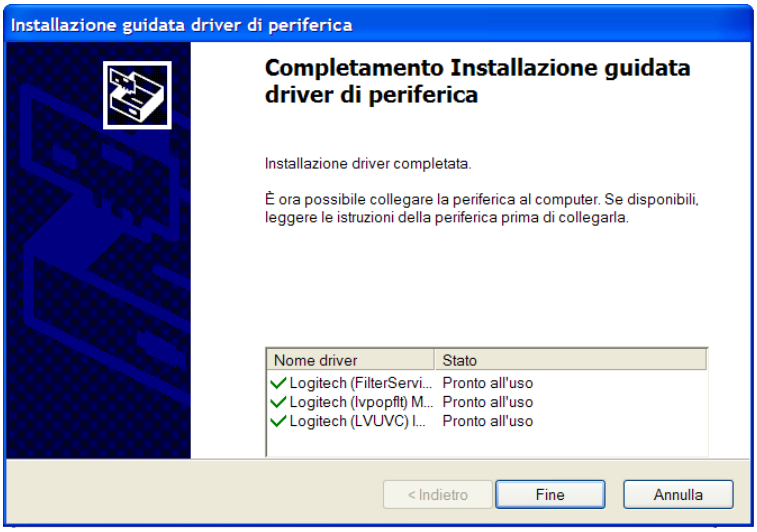

Installazione guidata driver di periferica
Completamento Installazione guidata driver di periferica
Installazione driver completata.
È ora possibile collegare la periferica al computer. Se disponibili, leggere le istruzioni della periferica prima di collegarla.
Nome driver
Stato
Logitech (FilterServi... Pronto all'uso
Logitech (lvpopflt) M... Pronto all'uso
Logitech (LVUVC) I... Pronto all'uso
< Indietro
Fine
Annulla

Figure 7 – End of driver installation

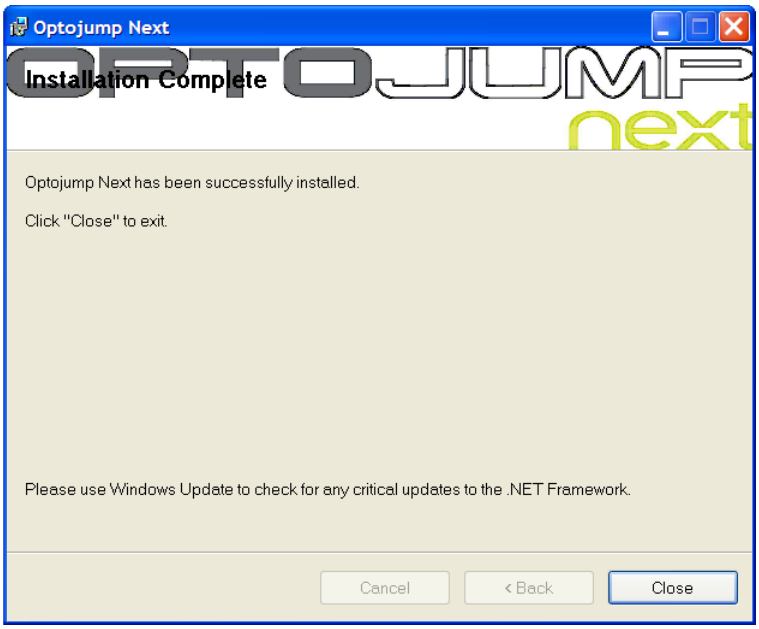


Figure 8 – Installation – completed.

By clicking on <Close> you exit the installation procedure.

During the entire installation procedure, it is possible to return to the previous window by clicking on <Back>.

3 DESCRIPTION

The welcome screen of the OptoJump Next software shows a horizontal bar with the most important menu items and an area with News and Events, automatically updated from the web site www.optojump.com in the appropriate language. If a network connection is not present, the information will not be downloaded; it is also possible to deactivate the Internet connection with a configuration parameter (see chap. 5.4.1.7). Click on a news title or an event to open the complete description in a browser window.

OptoJump Next
OPTOJUMP
15:48:19 18/05/2010
ATHLETES
TEST
RESULTS
UTILITY
HELP
EXIT
News
Events
Case Study about Optojump.Com portal
14/01/2010
Kentico, a famous Software House in the CMS branch, publish a case study about our portal optojump.com
New Photogallery and Videogallery
12/10/2009
Two new photo-amp; videogallery are online
Case Studies and Test Tipologies
21/08/2009
Some interestingcase studies of several sports and samples of test tipologies are published
User Manual
17/07/2009
English User Manual now available
Microgate Systems at Li Ning's CBDC 4th edition
22/04/2009
Optojump Next was used for evaluating professional youth players come from clubs in CBA(chinese basketball association) during one of the greatest b-ball training camp in China.

Figure 9 – First page

The interface with which the OptoJump Next system is managed is divided into three main sections: Athletes, Tests and Results.

3.1 ATHLETES

In this section the profiles of the athletes or patients are created and catalogued. Each profile can contain many items of information (personal data, notes, athlete's photo, etc.). Membership Groups can be created to improve subdivision into different categories when the tests are to be performed. For example, a group "Football" can be created with its subgroups 'Attackers', "Midfielders" and 'Defenders'.

3.2 TEST

This section is the software's nerve center. It is accessed to devise and configure new tests (jump, reaction, running, etc.) and to perform tests by choosing from the pre-defined tests or those created by the user. It is then possible to program sequences of tests in order to make one or more athletes perform a number of tests.

During performance the user sees the evolution of the test in real time by means of numerical, graphical and video data. This data can be saved and stored for immediate review or future consultation. Depending on the user's requirements, information not of interest can be temporarily hidden in order to highlight other information. For example, the charts and tables can be hidden to show only the videos in larger size.

3.3 RESULTS AND VIDEO ANALYSIS

In this section it is possible at any time to call up previously performed tests. By displaying the results, it is possible to compare the images with the numerical and graphical data. The video images are synchronized with the athletes' movements. This makes it possible to accurately establish what happened when a certain piece of data was acquired. For example, if a contact time is too long, it is possible to find out why by observing the images at the time that value was recorded.

The speed of the video can be reduced down to 'frame by frame' or still picture. There is also a video analysis utility that makes it possible to draw on the still picture, thanks to various graphical tools (lines, arcs, circles, ruler, goniometer, etc.).

In the Results section, it is also possible to compare two or more tests without the assistance of additional software: for example, it is possible to ascertain the performance of an individual over a period of time or compare the results of tests performed by two or more different athletes.

All the data, numerical as well as graphical, can be printed or exported in the most common formats (PDF, Excel, Word and HTML).

4 OPTOJUMP NEXT DRIVER AND HARDWARE INSTALLATION

4.1 DRIVER INSTALLATION

For correct functioning of the program, the respective drivers for the OptoJump Next hardware and the webcam must be installed.

The OptoJump Next software installation file already contains the required drivers.

In the case of the Vista operating system it has been found that if the installation program is not run as 'Administrator', the drivers are not installed. In this case install the two drivers separately. These are available on the Microgate USB key supplied with the hardware or on the site www.optojump.com in the 'Support' section.

To check that the drivers have in fact been installed, connect the two devices (OptoJump Next hardware and webcam). If installation has not taken place, the operating system will signal an error. In this case disconnect the hardware, install the drivers again and reconnect the hardware.

4.2 OPTOJUMP NEXT HARDWARE INSTALLATION

Attention must be paid when installing the OptoJump Next bars, particularly when inserting the caps for connecting the bars.

The distinctions to be made between the bars are between Tx and Rx and additionally between bars with interface (silver drum at start of bar) and without interface. Only the interfaces have an OFF switch.

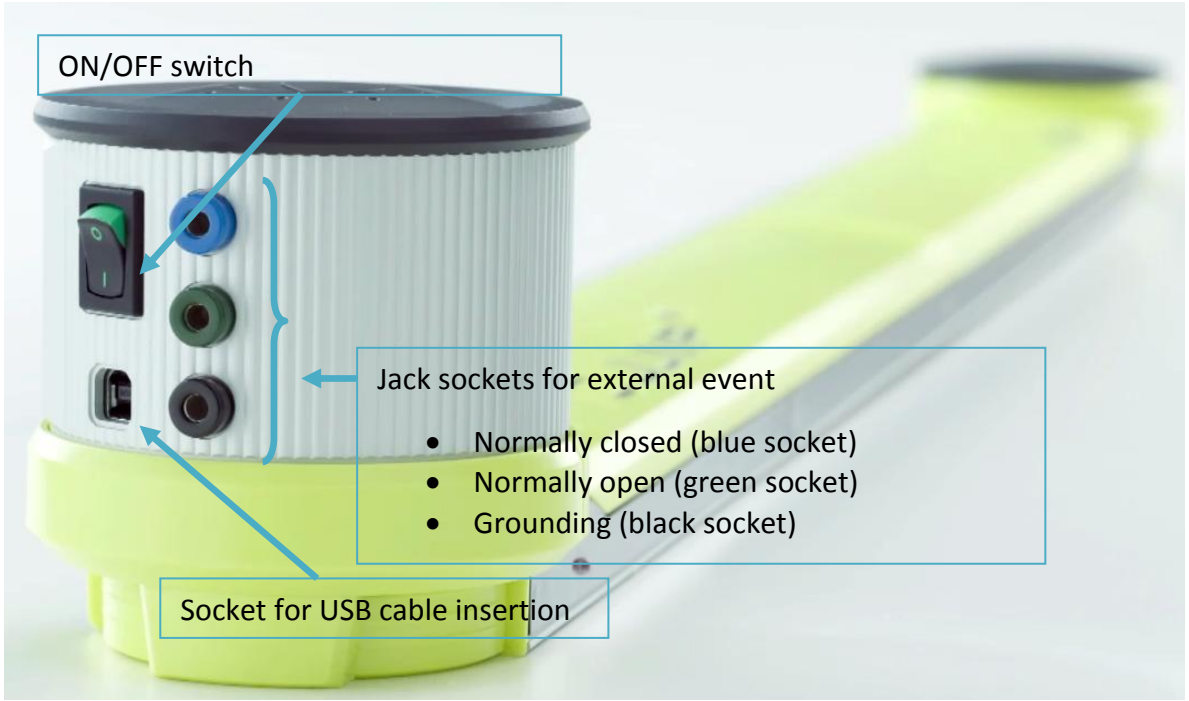


Figure 10 – Bar with interface

Below is the step-by-step procedure for bar installation:

- Switch off the OptoJump Next device
- Place the two OptoJump Rx and Tx bars facing each other at a minimum distance of one meter (maximum 6 meters)

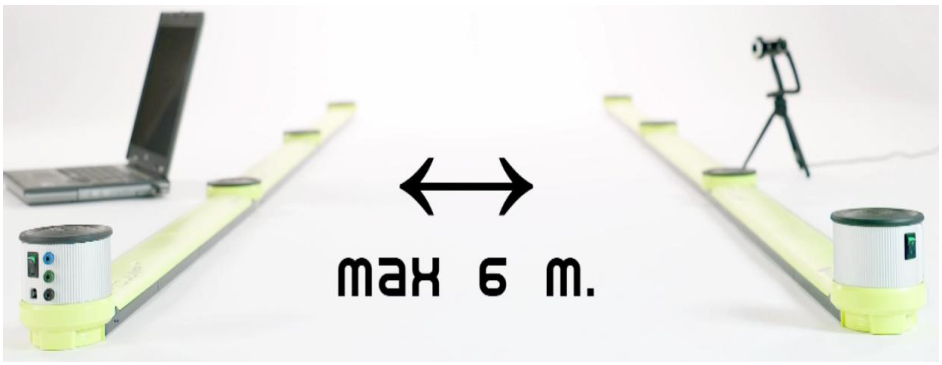


Figure 11 – Maximum distance

- If a number of bars connected together are used, pay attention to the insertion of the caps (see figures below). Check that the caps are firmly inserted. If insertion is incorrect, the software may not function correctly.

Figure 12

Figure 13

Figure 14

Figure 15

To **mount** the connection cap just insert the cap in the dedicated slots and apply light pressure on both sides until it has been completely inserted (make sure it is parallel with the two bars; the two connectors should slot in simultaneously).

The cap can only be inserted one way round. If you find that the cap will not go in, turn it 180°.

DO NOT force if insertion is difficult, as this would risk bending the connection pins!

Figure 16 – Cap mounting

Figure 17 – Inserting with light pressure

To **remove** the cap, grip the two side tabs and pull upwards symmetrically. Alternatively, you can hold one of the 2 bars down firmly and carefully lift the other until the cap comes off.

Figure 18 – Cap removal

Figure 19 – Alternative method for removing the cap

- Connect the USB cable from interface Tx to the computer USB port. The USB port on the computer is marked with the symbol .

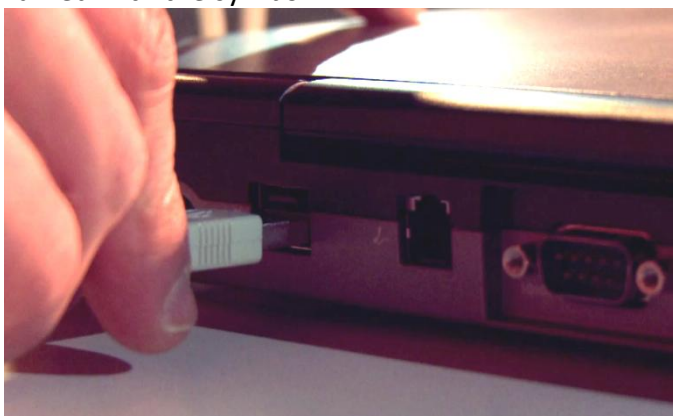


Figure 20 - PC connection

- If more than three OptoJump Next meters are used (three Tx bars and three Rx bars), we recommend you use the adaptor
- Switch on the OptoJump Next device
- Check that the bars are correctly positioned (Rx LED green)

Figure 21 – Led indicator

If the software is being installed for the first time or being re-installed, the operating system will load the correct driver (see section above).

At this point the OptoJump device is ready for use.

If other bars are connected, remember to switch the device off and switch it back on.

If you notice that the device is not working correctly, perform an OptoJump Next bars Test (see chap. 5.4.3).

NB: Do not mix 10 mm and 30 mm bars. The bars are clearly marked and distinguishable with regard to both resolution (10 and 30) and for TX and RX

Figure 22 - RX bar

Figure 23 - TX bar

4.3 Power Supply

OptoJump Next runs on batteries with a life dependent on the number of bars connected (see OptoJump Next Battery life). The blinking LED next to the adaptor connector shows the battery charge status:

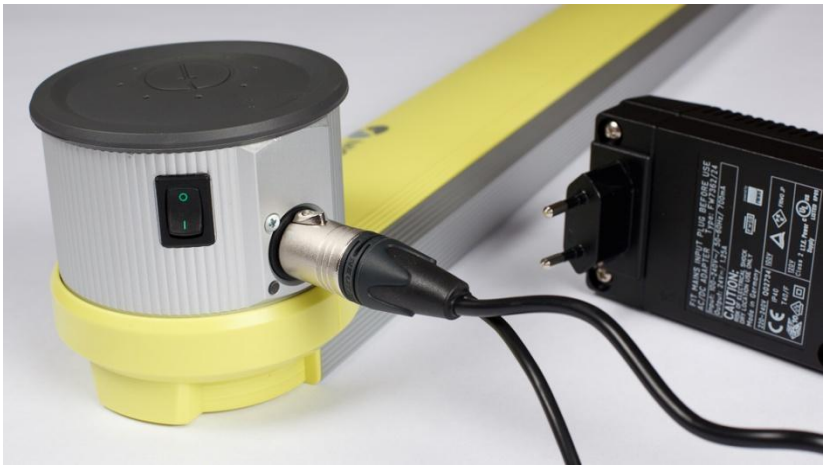
Green-blinking = battery sufficiently charged

Red-blinking = low battery; the bars must be connected to the mains supply

Orange = battery being recharged

Figure 24- Battery charge status LED

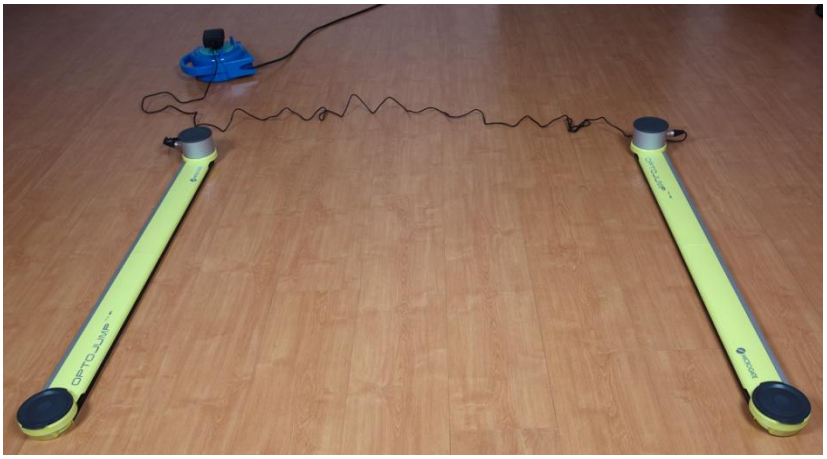
To recharge the battery, connect the adaptor plug to the dedicated socket on the drum.



The TX RX bars can be recharged simultaneously using the dedicated cable that connects the second drum to the adaptor.

Figure 25 - Adaptor and cable for second bar

The connection cable is long enough to make it possible to keep the bars at a normal distance (5 - 6 m) and therefore to work normally even when connected to the power supply.



4.3.1 OPTOJUMP NEXT BATTERY LIFE

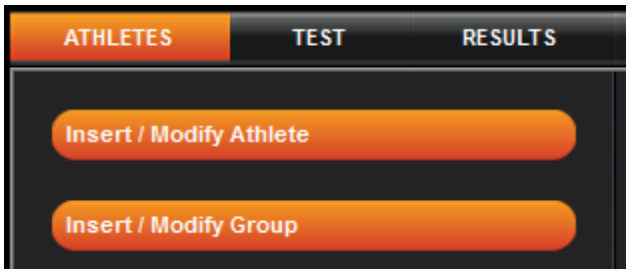
Battery life expressed in hours

Bars	1	2	3	4	5	6	7	8	9	10
Theoretical Tx96	11.54	5.88	3.93	2.88	2.27	1.86	1.57	1.34	1.14	1.02
Theoretical Rx96	14.40	7.89	5.39	4.11	3.25	2.69	2.28	2.00	1.74	1.55

5 DESCRIPTION OF FUNCTIONS

In this chapter all the functions of every menu of the OptoJump Next program will be described, starting with the functions of the main menu.

5.1 ATHLETES



5.1.1 INSERT / EDIT ATHLETES

In this section all the athletes stored are displayed.

Figure 26 – Edit Athletes

Click on the names of the columns (Last name, Name, Date of Birth) to order the list according to that field; clicking on the same column again reverses the order (A…Z, Z…A).

To search for a particular athlete or to filter data (e.g. search for all athletes beginning with “Ros”), insert the text in the box at the top left and press <Search>. To remove the filter, press <Delete filter>.

Pressing the button <New Athlete> opens a new panel in which the new athlete’s data must be inserted. Last name is the only compulsory field. Also, the weight (given in kg or pounds depending on the unit of measurement chosen in Basic Configuration) is necessary if you wish to use the tests to determine the value for total power or total energy.

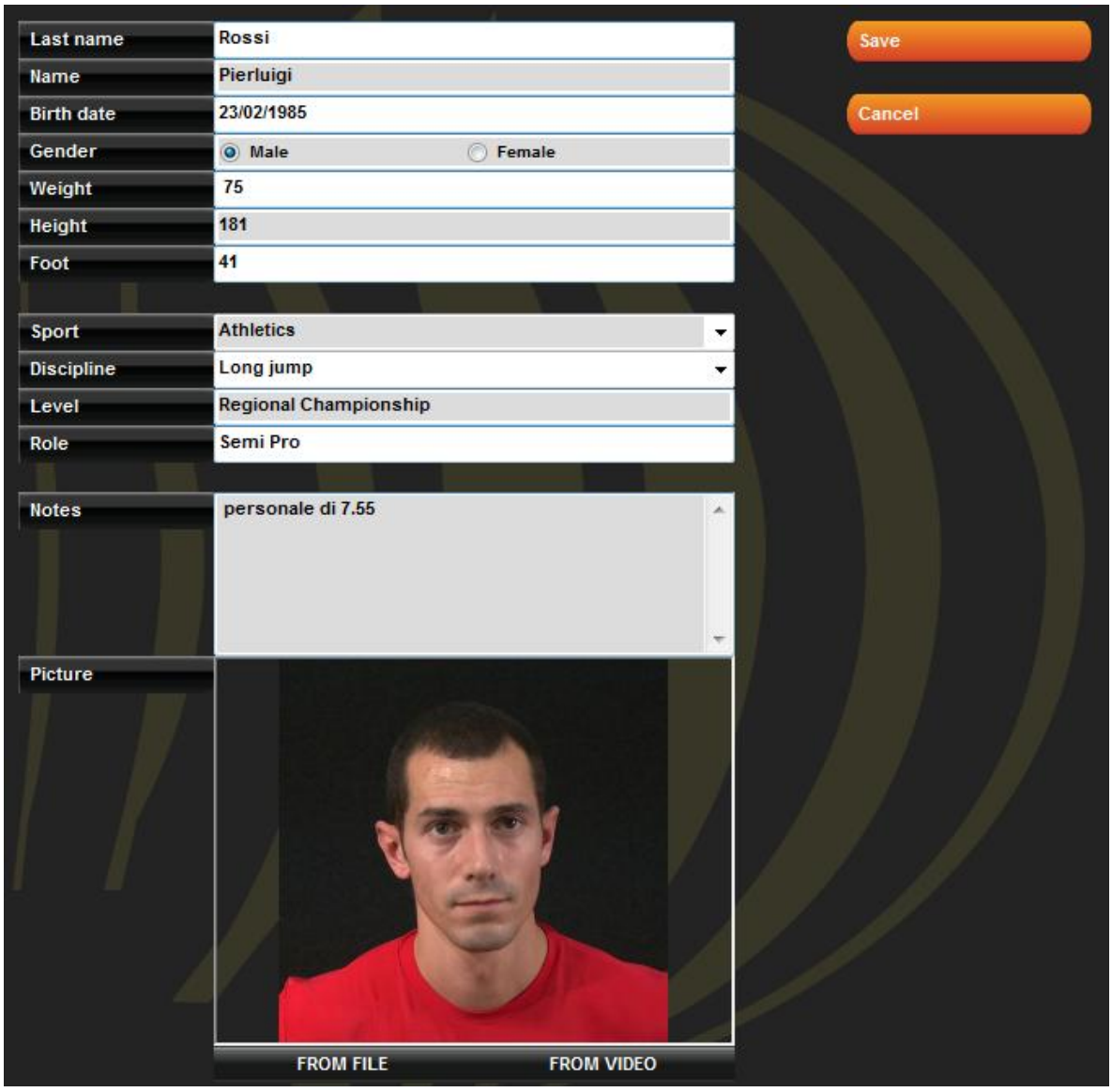


Figure 27 - Athlete Data input mask

The function for associating each athlete with a photo is useful, especially for trainers and coaches with many athletes to assess. This can be taken from a file previously saved on disk (in .jpg or .bmp format), or taken 'on the spot' with a previously connected webcam. In the first case, click on <From File> and select the desired photo from a folder; in the second case, click on <From Video>, wait for the Live image to appear, frame the athlete and press <Acquire>.

5.1.1.1 Athlete Data Input Mask

To edit the data of a stored athlete, select him/her with the mouse and press <Edit Athlete>: in the Athlete Data mask fields may be edited and saved (or cancelled going back to the list).

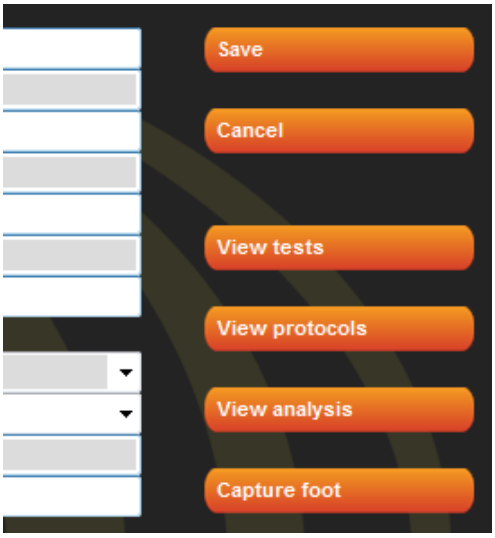


Figure 28– Command in the Edit panel

Furthermore, three buttons allow the user to view tests, protocols, and analyses of the current athlete (actually a filter is created as explained in section 5.3.1)

The command <Capture foot> measures the foot in cm (i.e. in 'number of LEDs', which are then converted into centimeters or inches according to the unit of measurement used). Click the button, position one foot inside the bars (parallel to them) and click on <Confirm>. After a few seconds the measurement is displayed and can be confirmed or repeated.

The measurement (essential for the treadmill tests) is useful only with the 1 cm OptoJump Next version, as the resolution of the 3 cm version is too low to give a reliable value (e.g. depending on how the foot is placed, the measurement can vary from 15 to 18 cm). The value is saved in the database associated with the athlete and is displayed in the mask; the editable field 'foot' is only for personal data and can be used to write the measurement in any unit (e.g. 41 EUR, 7 ½ US, 8 UK, etc.).

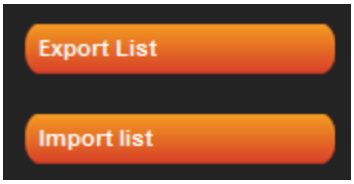
In the athletes list the following commands are available. To eliminate him/her, press <Delete Athlete> (WARNING: When deleting an athlete all his/her tests, protocols, and analyses will be deleted without any possibility to restore them).

To insert an athlete into a group, select from the list, press <Add to a group>, select the group to insert him/her in (possibly using the right arrow to select a dependent subgroup) and press <Add to a group> again. Press <Back> to return to the athletes' list.

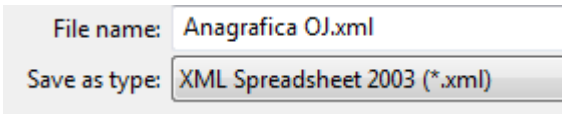
For the management of groups and other ways of associating with groups, we suggest you read the next section.

By pressing <Export>, the athletes' personal data can be exported to a file with the extension 'xml', which can be used with Excel (Excel XP versions 2003 and 2007) or with other programs using this well-known exchange format.

5.1.1.2 IMPORTING AND EXPORTING ATHLETES' PERSONAL DATA EXCEL



Once compiled in OptoJump Next, the Athletes' Personal Data can be exported into an Excel-compatible format (XML Spreadsheet 2003). Press <Export List> and specify the name and location of the XML file. If you have Microsoft Excel installed on your computer, double-click on the file icon to launch the program and view the columns with all relevant athletes' data.



If you already have an athletes' list created with another software, it can be imported with OptoJump Next preparing a normal Excel file with the same format as the export file (number, location, column headers and format 'XML Spreadsheet 2003'). It is recommended to export an empty personal data base to create a file template and fill it with the desired information. Attention must be paid to the birth date format (DD/MM/YYYY) and the 'Gender' field ('M' or 'F'). The pre-configured fields 'Sport' and 'Discipline' are only available from the dropdown menu. Possible errors during the import are listed in a log window at the end of the import (if the error is not blocking, the athlete is added anyway, but with any possible wrong fields empty).

5.1.2 INSERT / EDIT GROUP

In this section infinite groups and subgroups can be created, making it easy to manage the athletes' personal data.

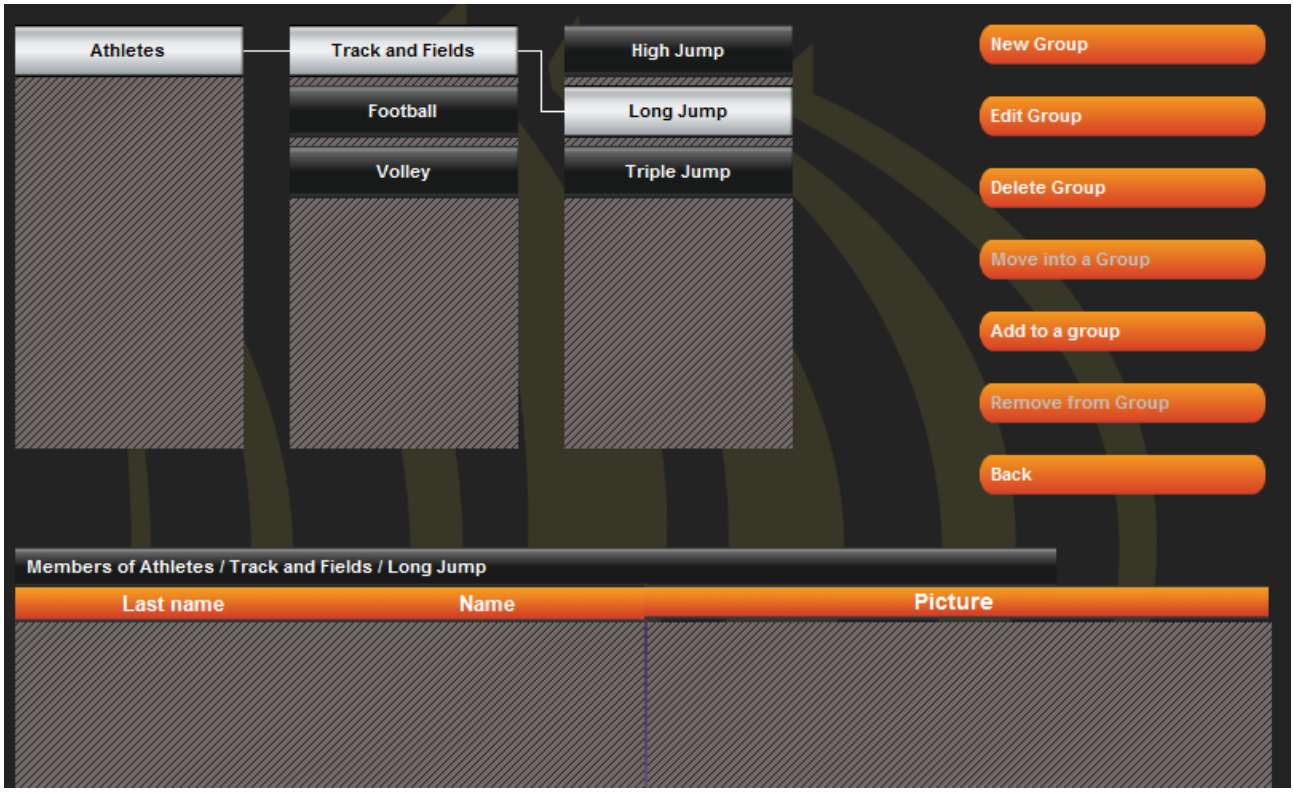


Figure 29 – Managing groups

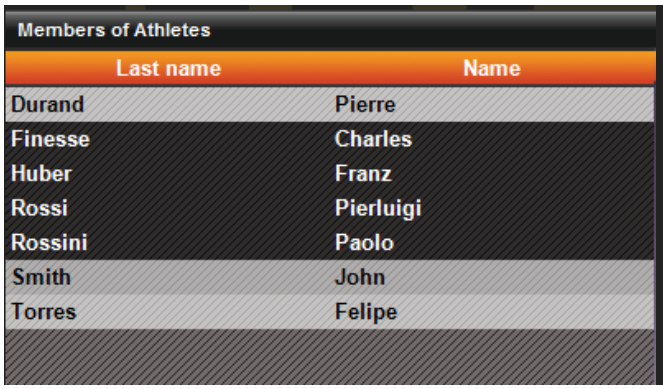
As a default there is always a group called 'Athletes' which is the Parent group of the ones we will subsequently create. All the athletes we insert are automatically added to this group.

To create a subgroup, choose the parent group, press <New Group>, key in the name and confirm (e.g. if you want to create 'Team A' as a 2nd level group, select 'Athletes' and press <New Group>, whereas if you want to create a 4th level group under Midfielders, make sure to select it before pressing <New>).

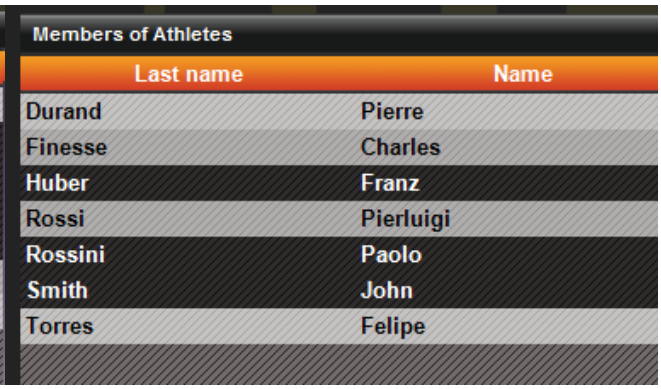
When a group is selected, the grid below will show the athletes belonging to the group chosen and its 'relationship'.

To add one or more athletes to a group there are two other possibilities:

- Select the group to which you want to add an athlete and press <Add to a Group>, select one or more athletes by checking them in the grid and press <Confirm>. It is possible to use <Select All> or <Deselect All> to speed up checking operations. Press <Cancel> to exit this function without adding athletes.
- Select the root group 'Athletes' (which contains all athletes), select one or two athletes by clicking on them (see below) and drag them with the mouse (the classic drag ‘n drop function) to the destination group. The message 'Done' will confirm that the operation has been successfully completed. To make multiple selections, use the SHIFT keys to select a range of athletes (from… to…) or the CTRL key for selections that are not adjacent.



Selecting a range. Click on 'Finesse', keep SHIFT pressed, click on 'Rossini'



Selecting a number of non-adjacent athletes: keep CTRL pressed and click on the athletes

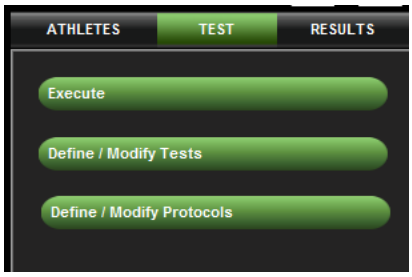
It is also possible to move athletes from one group to another with these two methods:

- Select the source group of an athlete you want to move, select one or more athletes, press <Move into a Group>, select a destination group and press <Confirm move>. Press <Cancel> to cancel the operation in progress.
- Select the subgroup from which to transfer the athlete or athletes and perform the same drag ‘n drop operations described above. The difference between operating from the root group “Athletes” or from others is that in the first case the athletes are always copied. When moved from one subgroup to another, they are transferred without copying

With <Delete Group> the group selected and its dependent subgroups are eliminated (but not the athletes that formed it), while with <Edit Group> its name can be changed.

With <Remove from Group> the athlete selected in the grid is removed but not eliminated from the database. The button is disabled when no athlete is selected or when the first level group “Athletes” is displayed.

5.2 TEST



5.2.1 EXECUTE

In this section the pre-defined tests or protocols are carried out. To define a test or protocol, see the sections below. In addition, before performing a test, at least one athlete must be inserted in the database.

*Figure 30 -Execute*To perform a trial it is advisable (but not obligatory) to follow the direction of the operations indicated by the red arrow at least the first time you enter this section.

The basic flow is

- select the athlete
- select the test type (using tests or protocols)
- optionally configure some viewing parameters
- press Execute and have the athlete perform the jump test or the running/gait test
- Save, Cancel or Repeat the test

Let's look at an example:

1. Choose one or more athletes by pressing the orange button <Select> under the 'Athletes' box, then tick one or more athletes in the grid and press <Confirm>. Shortcuts are possible using the <Select All> and <Deselect All> buttons, whereas if the athlete database has been organized in groups and subgroups, a group can be selected with <Select Group>.
2. Select one or more tests by pressing the green <Select> button under the 'Test' box; select one of the three test macro-typologies (Performance, Gait Analysis, Rehab) to view the relevant test definitions, then tick one or more tests in the grid and press <Confirm>.

2a. As an alternative to the selection of a number of tests, it is possible to select a pre-defined protocol. Click the green <Select> button under the 'Protocols' box, select the macro-typology and click on one of the protocols followed by the <Confirm> button. It is not possible to select more than one protocol at once. When the protocol has been chosen, the test list is compiled with the tests that define the protocol.

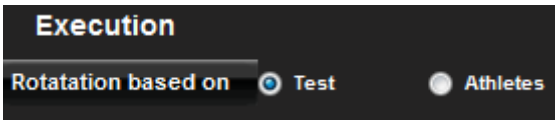
3. Check the configuration by pressing <Configure> (see chap. 5.2.1.1 Execute Configuration
4. Execute the test by pressing <Execute> (or <Repeat> if a test has already been performed)
5. Wait for activation of the Webcam (if installed) and the sound signal that gives the 'all clear' to perform the chosen test.
6. Follow the instructions at the bottom left which, depending on the test definition, will tell you to 'enter' or 'exit' the test area (i.e. the space between the bars).
7. Save the test performed with <Save>, watch the video again with <Review> or cancel the test with <Cancel>. Press <Repeat> to have the athlete repeat the test without moving to the next test (or the next athlete). If <Repeat> is pressed before saving, the test will be deleted. Press <Insert Note> to add a note to the test that has just been completed.

Test cycle

We have seen that it is possible to select more than one athlete and/or trials (using multiple selections or choosing a protocol, (a pre-defined sequence of pre-defined tests), and therefore have a 'cycle' of tests performed. In this case the arrows will appear in the respective boxes for moving the selected data.

Let's suppose we select two athletes ('Rossi' and 'Smith') and two tests ('Squat jump', 'Stiffness').

Depending on how the parameter 'Rotation based on…' is set, the following types of sequence can be set:



Rotation based on a **Test**	Rotation based on **Athletes**
Rossi/Stiffness	Rossi/Stiffness
Rossi/Squat jump	Smith/Stiffness
Smith/Stiffness	Rossi/Squat jump
Smith/Squat jump	Smith/Squat jump

TIP: When athlete, test or protocol selection is made, it is possible to double-click with the mouse on the line of the grid to select the single data item and confirm automatically.

The videos are always acquired in size 640 x 480, even if they are displayed small.

The test acquisition can be simulated even if the OptoJump Next hardware device is not connected. The keys that simulate the device are:

- **F8** – when pressed simulates the status "*inside the measurement area*"; when released simulates the status "*out of the measurement area*"
- **F4** – every time it is pressed, it simulates an external impulse (e.g. photocell, etc.)

Note: the only function that cannot be simulated is the acquisition of a Sprint/Gait test: it is not possible to know the length of steps. While this type of test is allowed, it will finish without the acquisition of steps.

5.2.1.1 EXECUTE CONFIGURATION

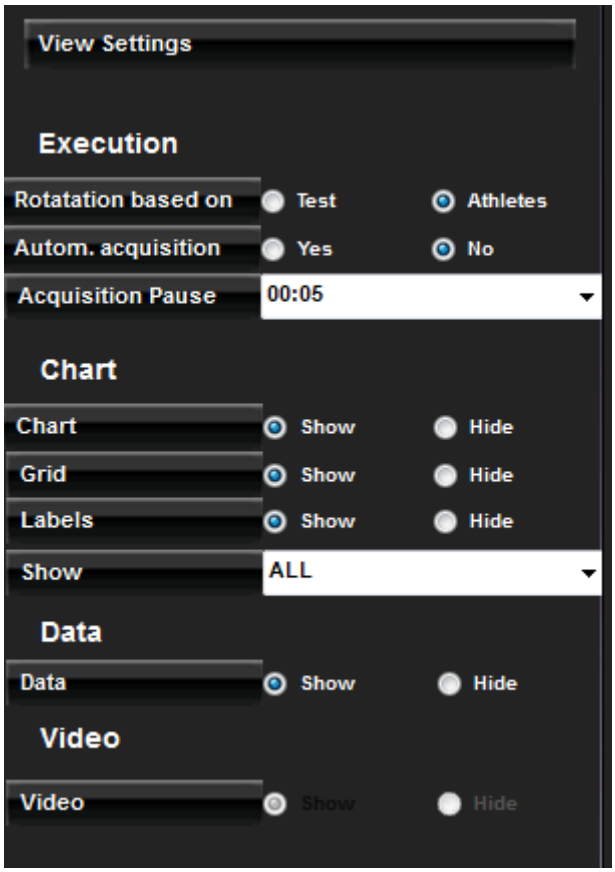
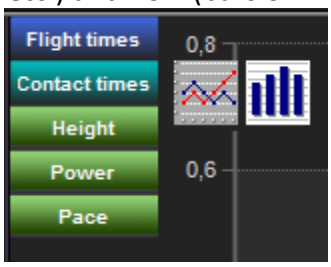


Figure 31 – Execute Configuration

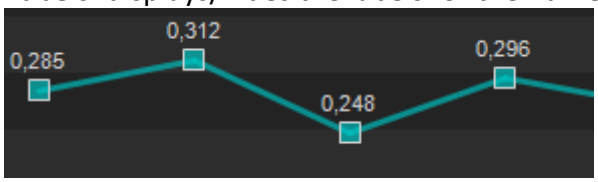
Test data viewing can be configured by the user. The parameters are:

- Execution
  - **Rotation based on:** if more than one test or athlete is selected, this indicates the chosen mode
    - **Test:** after each performance, the next test begins for the same athlete
    - **Athlete:** after each test performance this goes on to the next athlete doing the same test
  - **Automatic acquisition:** if this parameter is set to Yes, it is possible to skip the manual saving phase at the end of each test; when the athlete finishes a test, it is saved, then, after a few seconds (as configured in the parameter 'Acquisition Pause') the next test begins automatically (performed by the same athlete or by another, depending on the settings).
  - **Acquisition Pause:** indicates the pause time between one test and another, which are acquired automatically. Used only if Automatic Acquisition = YES

- ***Chart***
    - **Chart**: shows/hides the chart during the execution; if 'show' is chosen, it is possible to choose which values to display (Flight times, Contact times, Height, Power, Pace, etc.) and how (bars or lines)



    - **Grid**: shows/hides the white-dotted lines forming a grid on the chart
    - **Labels**: displays/hides the labels for the numerical values on each spot of the chart



    - **View**: displays the last n-number of acquired data items.

- Data
    - **Data**: shows/hides the numerical data table with its lines and columns
- Video
    - **Video**: shows/hides the videos acquired by the webcam

5.2.2 Define / Edit Tests

In this section the definitions of the tests to be performed can be defined or edited.

As described in the section above, in the OptoJump Next software the definition, execution and viewing of tests are often characterized by three categories: Performance (athletic performance), Gait Analysis and Rehab (rehabilitation).

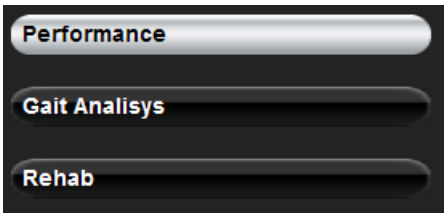


Figure 32 – Test Macrotypology

These categories are used to filter data in order to prevent, for example, viewing the results for athletic performance together with those for rehabilitation. Click on one of the three categories to view the list of tests pre-defined by Microgate or those you have added yourself in the grid (in the example below 'Three Jumps' is a test added by the user).

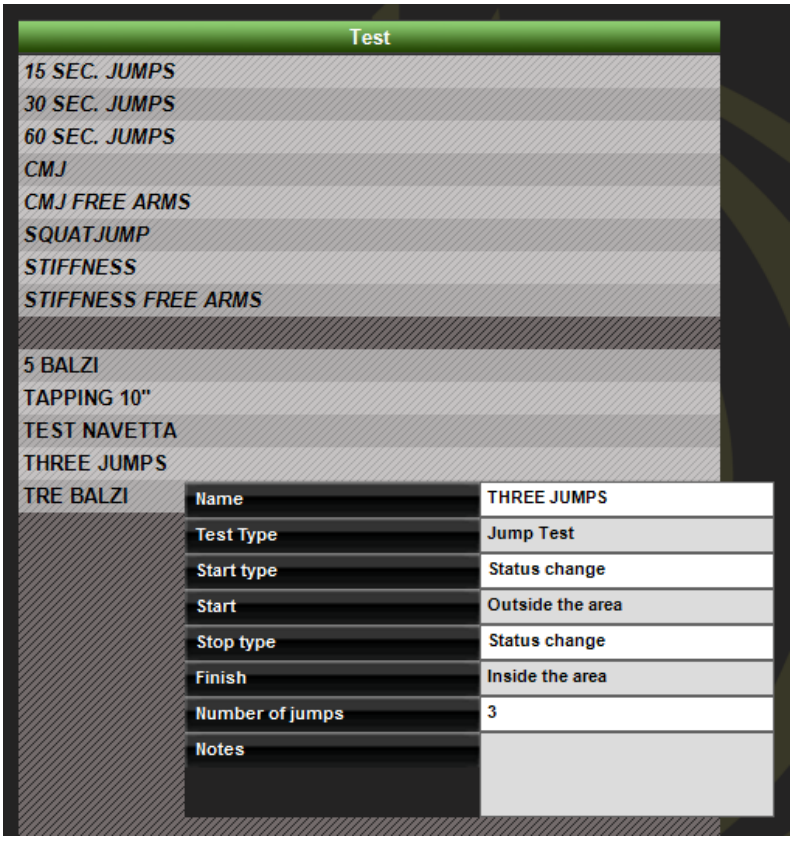


Figure 33 - Define / Edit Tests

If the mouse is pointed on a test, its characteristics (which are those that will be used to define a new one) will be displayed.

By pressing <New Test> the section for defining a test is opened.

The fields necessary for defining a test are the following:

- **Name:** name identifying the test type (e.g. 'left foot monopodalic' or 'continuous jumps 30 seconds', etc.)
- **Test Type:** this type indication is very important and conditions the fields below, which appear dynamically only after the type has been chosen from this drop-down menu:
    - **Jump Test:** type of test that measures flight time (and consequently height), as well as contact time during a series of jumps (in the former version this was called *Contact/Flight time)*
    - **Reaction Times:** measures the reaction time to a visual or sound stimulus
    - **Sprint and Gait Test:** test for the analysis of a run or walk; in addition to flight and contact times, step or stride length, and consequently other indicative parameters are also registered (in the former version this was called *Walkjump*)
    - **Treadmill Running Test:** test analyzing running to be used on a treadmill (in the former version this was called *Rolljump*).
    - **Treadmill Gait Test:** test analyzing gait to be used on a treadmill
    - **Tapping Test:** frequency test registering separate data for each foot
- **Notes:** Mnemonic general notes on the test definition.
- **Example movie:** with the webcam connected it is possible to acquire a movie clip that can be viewed in the future as a reminder. Press <Acquire> to acquire the movie and <Play> to view it

5.2.2.1 MAIN AND SECONDARY PARAMETERS

The parameters of a given test type are divided into Main Parameters and Secondary Parameters. To switch from one mask to another, press the corresponding button on the right.

Secondary parameters are the same in the Utility menu under Basic Settings (chap. 5.4.1.2, 5.4.1.3 and 5.4.1.5). When creating a new test definition, the values of these parameters are retrieved from the general data. It is possible to edit them for a specific test for particular needs. All tests of that type will then have the modified parameter. It is also possible to change one of these parameters in a SINGLE test (the test of Mario Rossi on April 12th), without influencing the test definition itself.

Therefore it is important to understand how the secondary parameters have a hierarchical structure and a sort of parent/child relation.

Basic Configuration Parameter

↓

Test Definition Parameter

↓

Single Test Parameter

For example:

Under Utility/Basic Configuration set the 'Minimum contact time' to 60 ms. From this moment every time new types of 'Jump Test' are created, they will have a default value of 60 ms (if this value is acceptable, no further changes have to be performed in 'Secondary Parameters'.).

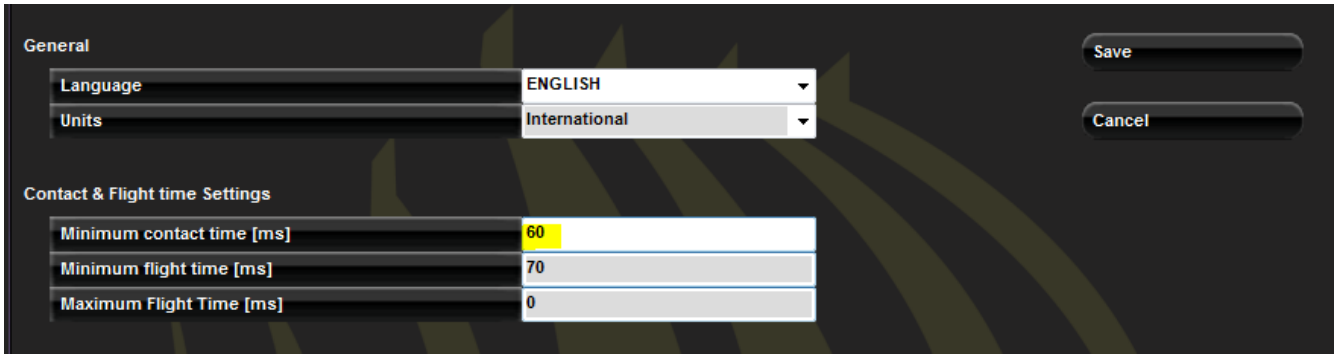


Figure 34 - Basic Configuration Parameters

Let's suppose that for special needs a new test type is needed (e.g. '*Three Jumps*') with a different value (e.g. 80 ms). Open <Secondary Parameters>, change the value, and save the test definition.

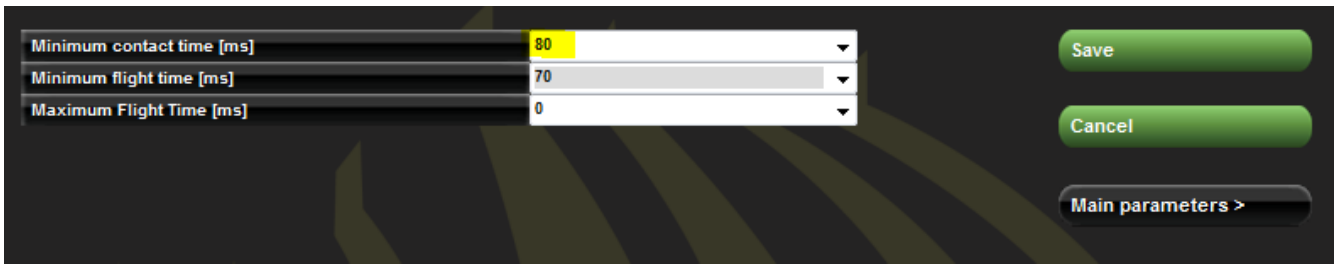


Figure 35 – Test Definition Parameters

Then have the athlete perform the test 'Three Jumps'. The single test, having inherited the values from its type, has of course the parameter 80 ms. Opening View Test (chap. 5.3.1) and pressing <Settings>, the following window is displayed:

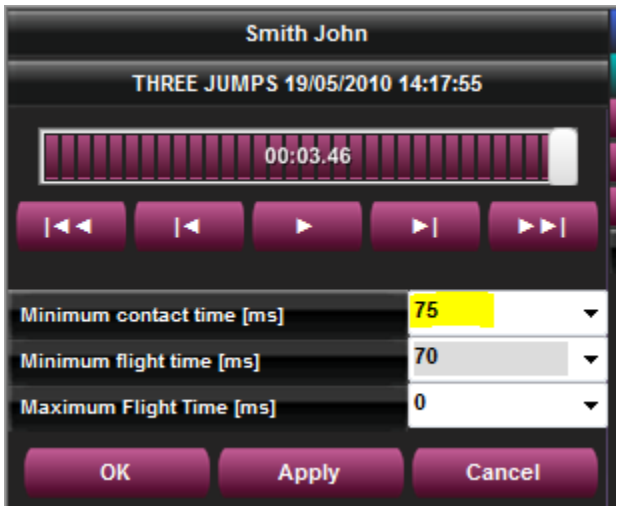


Figure 36 – Single Test Definition Settings

However it might be necessary to change the parameter ONLY for this single test. Insert for example 75 ms and press <OK> or <Apply>. After all values have been recalculated, the data in the table with the numeric results and charts will change. If the results are okay, confirm by pressing <OK> and answer <YES> when asked to save the data. (The difference between OK and Apply is that <OK> asks to confirm saving the new parameters and closes the function, whereas <Apply> does not close and allows to further adjust the parameters.)

If now the correct value proves to be 75 ms and all future tests should have this value, the parameter has to be changed in the test definition.

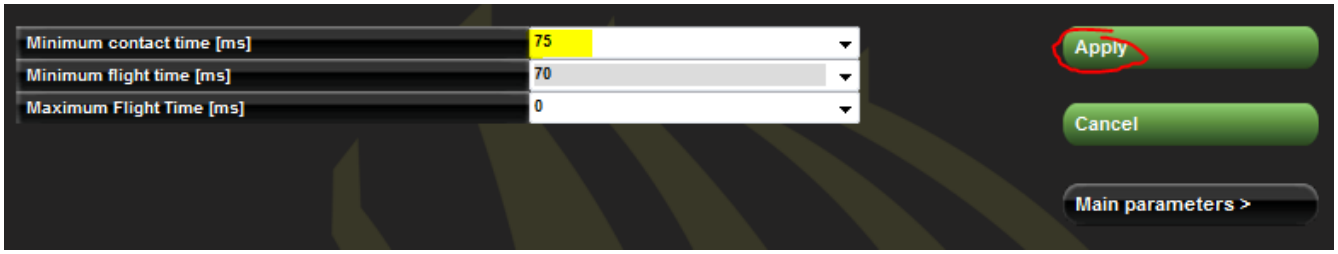


Figure 37 – Parameter editing in a Test Definition, when tests have already been performed with this definition.

TIP: With respect to Fig. 37 the button is called <Apply> and not <Save>.

Now it is possible to decide whether this change should be applied to future tests (press <NO>) or if the change should be applied also to all tests performed with this type (overwriting possible custom values set in the single tests); in the latter case, press <YES>.

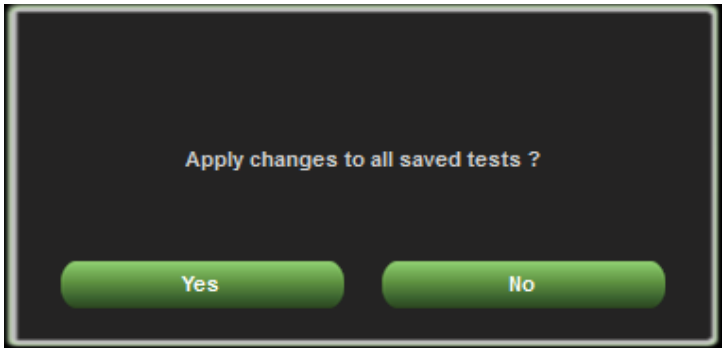


Figure 38 – Confirming the parameter application to tests that have already been performed

5.2.2.1.1 Parameter Template

The 'Template' field allows setting of secondary test parameters (in the definition but also at test level) following common usage cases. Let's suppose, for example, that a gait test is carried out on a modular system, with the athlete performing very short strides (typical of people who have had an injury), or shuffling the tip of the advancing foot. Instead of trying to change the parameters striving to find the best filter setting, you can choose one of the existing templates (i.e. 'shuffling gait') with parameters set automatically on the basis of our experience.

At present the templates apply only to the run/gait tests with modular systems, but in the future the concept will be extended to all test types and it will be possible to extend the template library via software upgrades.

The parameters changed by these first templates are those highlighted in the figure below.

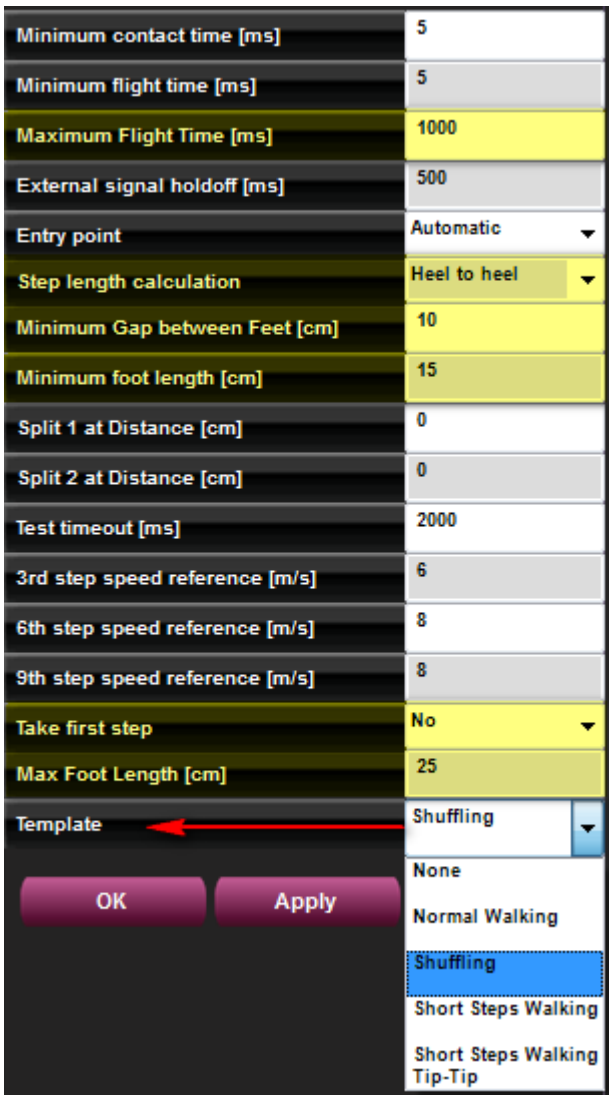


Figure 39 –Parameters Template

The available fields for the different test types are the following:

5.2.2.2 JUMP TEST

Main Parameters

- **Start type**: Indicates if the start of the test must take place with a 'status change' (i.e. entering or exiting the bars) or with an 'external impulse' coming from the jack sockets (start button, signal light, etc.)
- **Start:** indicates if at the beginning of the test the athlete must be '*inside the area'* of the bars or '*outside the area*'
- **Stop type**: As for the start, the end of the test can take place because of a *'status change'* or an '*external impulse*', or (in the case of time tests) the end of the test time (e.g. a test "Jumps 15 seconds" will have the Stop type = '*End of Time*').
- **Finish**: for the Stop type = '*Status change*' it is necessary to specify if, at the end of the test, the athlete must be '*inside the area'* of the bars or '*outside the area*'; in the other two Stop type cases this field does not appear
- **Number of Jumps**: appears only if the Stop type = '*Status change'* and specifies how many times the athlete must jump (from 1 to 99)
- **Test length**: appears only if Stop type = '*End of Time*' and specifies how many minutes:seconds the test must last (from 00:01 to 09:59)
-

Secondary Parameters

- **Minimum contact time [ms]**: allows to set a minimum contact time in milliseconds; if the contact time is shorter, it is considered incorrect; if the system registers a contact time shorter than this value, the time is added to the associated flight time (usually the previous one). This control can be enabled/disabled by inserting the value 0.
- **Minimum flight time [ms]**: allows to set a minimum flight time in milliseconds; if the flight time is lower, it is considered incorrect; if the system registers a flight time shorter than this value, the time is added to the associated contact time. This control can be enabled/disabled by inserting the value 0.
- **Maximum flight time [ms]**: allows to set a maximum flight time in milliseconds; if the flight time is higher, it is considered incorrect; if the system registers a flight time longer than this value, the time is not considered.

5.2.2.3 REACTION TIMES

Main Parameters

- **Start type**: Indicates what type of reaction the test must assess, that is:
- "*Visual stimulus*": on the PC screen a red circle becomes green after a random period of time; the athlete must 'react' to this stimulus (for example, by jumping)
- "*Acoustic stimulus*": the reaction stimulus is a sound emitted by the PC (using either an internal loudspeaker or a sound board) after a random period of time.
- "*Visual/Acoustic stimulus*": the visual (red/green circle) and the acoustic stimuli (beep from the PC) alternate randomly
- "*External impulse*": the start to calculate the reaction time is given by a device (e.g. a start horn or a start button) connected to the jack sockets
- **Start**: indicates if at the beginning of the test the athlete must be '*inside the area*' of the bars or '*outside the area*'
- **Minimum pause**: minimum pause time in minutes:seconds between one test and another (the pause will have this minimum value, but being random it will almost always be longer)
- **Number of repetitions**: indicates how many repetitions (from 1 to 99) the test must consist of
- **Sequence type**: the sequence can be '*Automatic*' (the test repetitions follow each other automatically) or '*Manual*' (at the end of each repetition the start of the next test must be confirmed)
- **Stop type**: this can only happen by 'Status change'

Secondary Parameters

- Minimum contact time [ms]: see above
- Minimum flight time [ms]: see above
- Maximum flight time [ms]: see above
- **Reaction time range [ms]**: indicates the time frame in milliseconds within which the reaction signal must be given randomly.

5.2.2.4 SPRINT AND GAIT TEST

Main Parameters

- **Start type:** Indicates if the start of the test must take place with a '*status change'* (i.e. entering or exiting the bars) or with an *'external impulse'* coming from the jack sockets
- **Start**: indicates if at the beginning of the test the athlete must be '*inside the area'* of the bars or '*outside the area*'
- **Starting foot**: if known, the foot with which the test starts ("*right*" or "*left*") can be indicated, otherwise leave as "*not defined*"
- **Stop type:** Indicates how the end of the test must be interpreted, i.e. as *'external impulse*' (e.g. a photocell at the end of the lane) or as '*timeout*' (the number of milliseconds of Test timeout can be customized in Utility – Basic Configuration)
- **Finish**: for the Stop type = '*Timeout*' it is necessary to specify if, at the end of the test, the athlete must be '*inside the area*' of the bars or '*outside the area*'
- **Test length**: appears only if Stop type = '*End of Time*' and specifies how many minutes:seconds the test must last (from 00:01 to 09:59)
- **Number of intermediate times**: Indicates how many intermediate times are inserted between the start and the stop (from 0 to 99)

Secondary Parameters

- Minimum contact time [ms]: see above
- Minimum flight time [ms]: see above
- Maximum flight time [ms]: see above
- **External signal holdoff [ms]**: is the holdoff time between two consecutive external signals. Caution has to be applied for this value, because it may depend on the type of test being carried out
- **Entry point**: allows to indicate if the entry point of the Sprint/Gait test is entering from the 'interface side' (drum) or from the 'opposite side'. If 'automatic' is chosen, OptoJump Next automatically calculates the direction, considering the LED nearest the center of the foot as the beginning of the LEDs.
- **Step length calculation**: allows to choose whether to calculate step length as the distance between the tips of two following feet or as the distance between the heels of two following feet (see also Figure 91 - Tip to Tip or Heel to Heel Step Length
-)
- **Minimum step length [cm or ft]**: is the minimum step length in centimeters (or inches), used as a basis to calculate the step length for a Run/Gait test.
- **Minimum foot length [cm]**: is the minimum foot length in centimeters (or inches), used to filter possible incorrect acquisitions.
- **Split 1 or 2 at distance [cm]**: insert at how many cm from the start the first or second split time will be taken; leave 0 to disable split times
- **Test timeout [ms]**: this is the end of test timeout in milliseconds; if during a Sprint/Gait test with 'Timeout' stop type no input or output signal is received from the

measurement area by the OptoJump device for a period longer than or equal to the time set here, the test is considered completed.

- **3rd/6th/9th step speed reference:** insert the reference speed for the 3^{rd}/6^{th}/9^{th} step in m/s; this option can be disabled by inserting the value 0.
- **Consider first step**: if set to No, the length of the first footfall is not taken into consideration.

For this test type the structure of the system has to be defined as well, i.e. how many bars the system is composed of and whether there are gaps between the bars.

In the field 'Number of bars', the number of connected bars must be inserted. This field is necessary for correct test acquisition. If the inserted number of bars differs from the number of bars actually installed, the software will signal this error suspending the test currently in progress.

Example: A system is made of 20 meters of OptoJump bars, all connected together, without gaps. The settings to make are the following:

The ⊖ and ⊕ buttons are respectively for removing or adding blocks of OptoJump bars. This function can be used, for example, in hurdle jumping, where between one hurdle and the next one interruptions are made connecting bars with a flat cable.

The 'Distance' field is for indicating the distance between the blocks in centimeters. The first 'Distance' (D_0) corresponds to the distance between the athlete's initial position and the first block. For example, in athletics, if the start is from the blocks, the distance from the springboard to the first block must be calculated. The other distances (D_1, D_2, etc.) indicate the distance between the last lens of a bar and the first lens of the following bar (end and beginning of the two half moons).

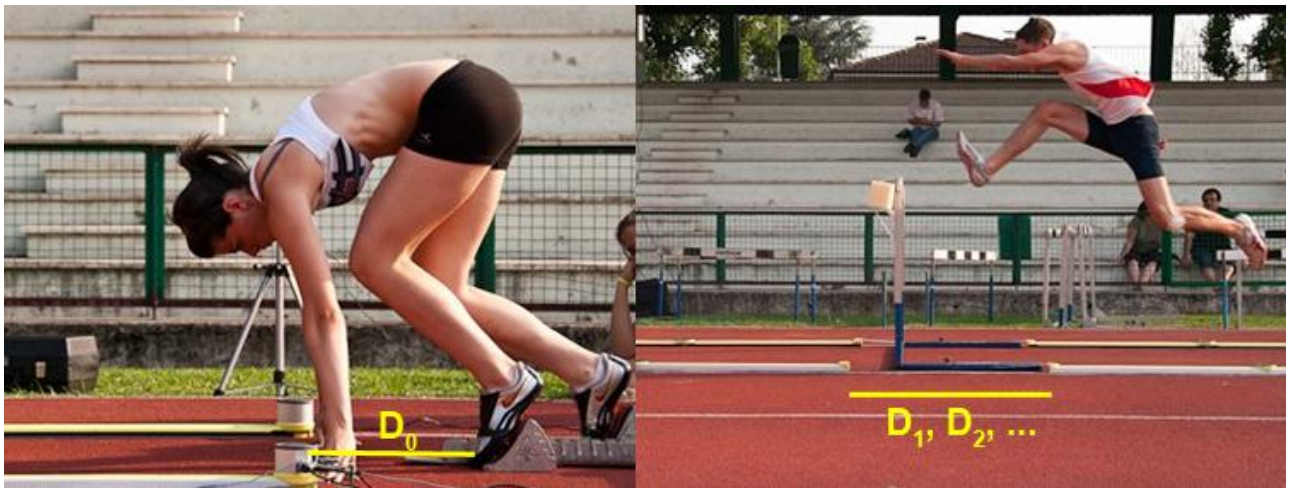


Figure 40– Example: bars with gap

A practical configuration example of a system of 30 m could be the following:

Starting block—50 cm – 13 meters OJ – hurdle – 8 meters – hurdle – 8 meters – hurdle – 1 meter

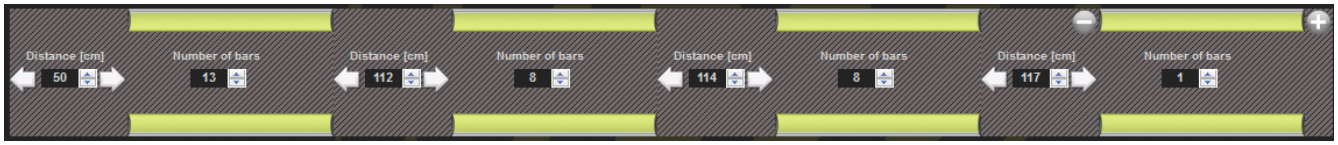


Figure 41 – Configuration of bar blocks

5.2.2.5 TREADMILL RUNNING TEST

Main Parameters

- **Start type:** this can only be '*Software command*'
- **Stop type:** this can only be '*Software command*' or *'End of time'*
- **Test length**: appears only if Stop type = '*End of Time*' and specifies how many minutes:seconds the test must last (from 00:01" to 59':59")
- **Treadmill speed**: indicates the speed in km/h the treadmill is set at; the setting range is 0.1-20.0 km/h with steps of 0.1.

Secondary Parameters

- Minimum contact time [ms]: see above
- Minimum flight time [ms]: see above
- Maximum flight time [ms]: see above

5.2.2.6 TREADMILL GAIT TEST

Main Parameters

- **Start type:** this can only be '*Software command*'
- **Stop type:** this can only be '*Software command*' or *'End of time'*
- **Test length**: appears only if Stop type = '*End of Time*' and specifies how many minutes:seconds the test must last (from 00:01" to 59':59")
- **Treadmill speed**: indicates the speed in km/h the treadmill is set at; the setting range is 0.1-20.0 km/h with steps of 0.1.
- **Direction**: Indicates, if the walking direction is 'Interface side' or 'Opposite side'. Therefore, if the interface drums are at the end of the treadmill choose 'Opposite Side', or vice versa.

Figure 42 – Direction: OPPOSITE Side

Figure 43 – Direction: IINTERFACE Side

Secondary Parameters

- Minimum contact time [ms]: see above
- Minimum flight time [ms]: see above
- Maximum flight time [ms]: see above
- Step length calculation: see above
- Minimum step length [cm: see above
- Minimum foot length [cm]: see above
- **Automatic Data Filter**: from 10% to 90% (default = deactivated); activating this parameter, the user can check if the values for flight time, contact time, gait time, swing time, and step length are within the average value +/- the chosen percentage. If one of these data is out of range, the table line will be deleted from the calculation of average values and the values on the grid will appear in strike-through format (e.g. average = 0.8, filter = 20%, all values above 0.96 and below 0.64 will be deleted).

5.2.2.7 TAPPING TEST

Main Parameters

- **Start type:** Indicates if the start of the test must take place with a '*status change'* (i.e. entering or exiting the bars) or with an *'external impulse'* coming from the jack sockets
- **Start**: indicates if at the beginning of the test the athlete must be '*inside the area'* of the bars or '*outside the area*'
- **Starting foot**: if known, the foot with which the test starts ("*right*" or "*left*") can be indicated, otherwise leave as "*not defined*"
- **Stop type:** Indicates how the end of the test must be interpreted, i.e. as *'external impulse*' (e.g. a photocell at the end of the lane) or as '*timeout*' (the number of milliseconds of Test timeout can be customized in Utility – Basic Configuration)
- **Finish**: for the Stop type = '*Timeout*' it is necessary to specify if, at the end of the test, the athlete must be '*inside the area*' of the bars or '*outside the area*'
- **Test length**: appears only if Stop type = '*End of Time*' and specifies how many minutes:seconds the test must last (from 00:01 to 09:59)

Secondary Parameters

- Minimum contact time [ms]: see above
- Minimum flight time [ms]: see above
- Maximum flight time [ms]: see above

In order to perform a Tapping Test it is important that the athlete's feet are vertical to the OptoJump bars

Figure 44 – Correct execution of a Tapping Test

5.2.2.8 VERTEC LIKE TEST

Main Parameters

- **Start type**: Indicates if the start of the test must take place with a 'status change' (i.e. entering or exiting the bars) or with an 'external impulse' coming from the jack sockets (start button, signal light, etc.)
- **Start:** indicates if at the beginning of the test the athlete must be '*inside the area'* of the bars or '*outside the area*'
- **Stop type**: As for the start, the end of the test can take place because of a *'status change'* or an '*external impulse*', or (in the case of time tests) the end of the test time (e.g. a test "Jumps 15 seconds" will have the Stop type = '*End of Time*').
- **Finish**: for the Stop type = '*Status change*' it is necessary to specify if, at the end of the test, the athlete must be '*inside the area'* of the bars or '*outside the area*'; in the other two Stop type cases this field does not appear
- **Number of Jumps**: appears only if the Stop type = '*Status change'* and specifies how many times the athlete must jump (from 1 to 99)
- **Direction**: the only possible option is 'opposite side', i.e. the drums of the bars must be positioned in the lower part

Secondary Parameters

- Minimum contact time [ms]: see above
- Minimum flight time [ms]: see above
- Maximum flight time [ms]: see above

After inserting the data, remember to press <Save> to save and return to the list of defined tests.

To review the parameters of a defined test, pass over them with the mouse, or double-click on them (this is equivalent to pressing <Edit Test>).

Editing a test definition is only possible if no tests using this definition have already been performed.

To delete a test definition, select it from the list and press <Delete Test>; obviously all the tests connected to this definition will be deleted!

To duplicate a test definition (useful for example, if a left-foot test has been defined and the same shall be applied to the right foot, or vice versa), select the test from the list and press <Duplicate Test>. This creates a copy of the test, which can then be renamed and fully edited.

The buttons <Import Test> and <Export Test> are for copying the definition of a test from one database to another. Press <Export Test> and save the XML file on your hard drive. Open another database (or create a new one) and press <Import Test> choosing the file previously saved.

The tests preconfigured by Microgate can be neither edited nor eliminated, but duplicated.

5.2.3 DEFINE / EDIT PROTOCOLS

In this section the protocols to be performed can be defined or edited. The protocols can be considered as a pre-defined series of tests to be performed in sequence (e.g. one 'Squat jump' + one 'CMJ' + one 'Jumps 15 sec.').

To create a new protocol, select one of the three test macro-typologies (Performance, Gait Analysis, Rehab) and press <New Protocol>. Insert a mnemonic name and optionally general notes.

Select the tests (in the desired order) that will make up this protocol using the symbol

If a mistake has been made or a test has to be removed from the protocol, use the symbol

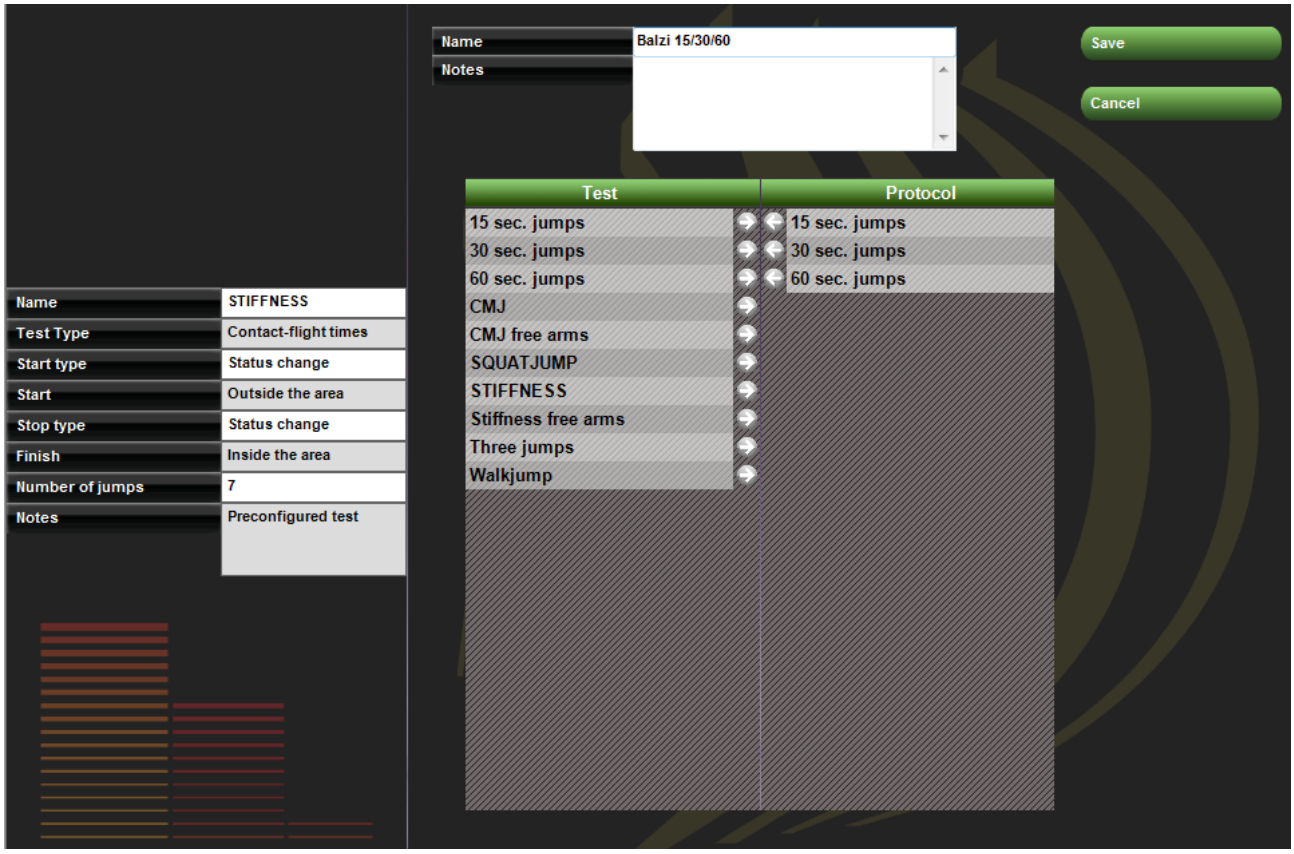


Figure 45 – Creation of a protocol

If you do not remember the parameters of a test definition, place the mouse cursor on it and its characteristics will be displayed.

After inserting the data, press <Save> to save and return to the previous section.

The command <Edit Protocol> allows to edit its name and notes and to change its composition, while <Delete Protocol> deletes its definition. Unlike the deletion of a test definition, the deletion of a protocol does not cause the chain-effect deletion of all correlated tests but only the connection they had with the protocol. After its deletion, the tests performed by the athletes will be found again as 'single tests' no longer related to the protocol.

5.3 RESULTS

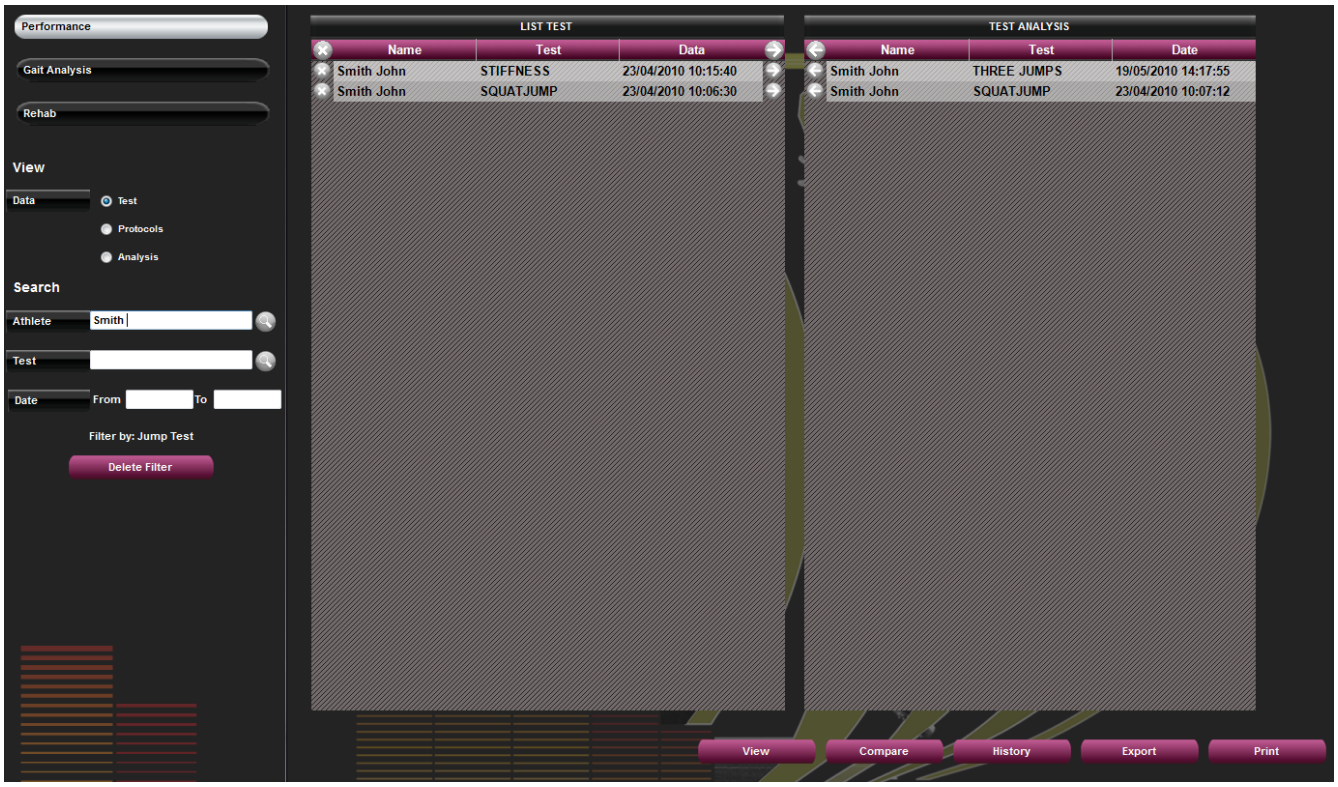


Figure 46 – Results

In the Results section, the performed tests or protocols are displayed. For better understanding these three terms are defined as follows:

Test: is a single test (e.g. 15" jumps) performed on a certain date by a single athlete.

Protocol: is a pre-defined list of tests to perform in sequence

Analysis*:* when a single test is displayed or when two tests are compared, certain configuration parameters may be set for the video, the table with numerical data, charts, reports, printouts, etc. It is furthermore possible to draw on still pictures, insert notes, 'sign', delete incorrect data, etc. All these operations can be saved in an *Analysis* (using a mnemonic name), which can then be recalled without having to reset all parameters.

The RESULTS window is divided into 3 parts (from left to right):

- FILTERS: panel for looking for a single test or for filtering according to various parameters
- TEST LIST: contains all the tests made, possibly filtered by your parameters; the same window also displays the list of saved analyses
- TEST ANALYSIS: contains the tests/analyses manually selected for viewing, comparing, printing, or exporting.

Filters Panel

Select one of the three macro-categories (Performance, Gait Analysis, Rehab) using the corresponding buttons. With the 'Data' radio button, select whether single tests, protocols or analyses should be viewed..

In the latter case, with the ⊕ and ⊖ icons expand or collapse the tests contained in the protocols.

Figure 47 – Expanded Protocols List

Choosing 'Analyses' all saved analyses will be viewed with the saving date (which can be much later than the execution of the analyzed tests).

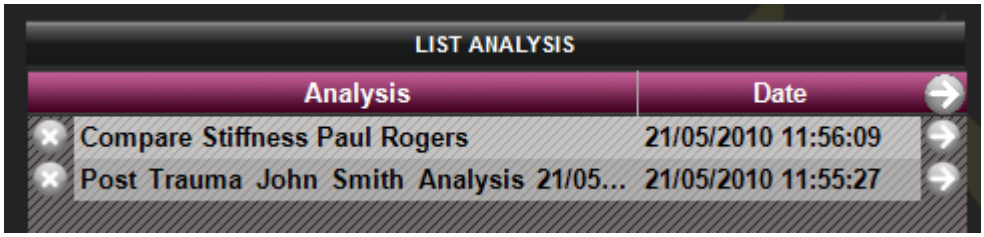


Figure 48 – Saved Analyses

To look for an athlete or a test/protocol, insert data manually into the search boxes (e.g. key in 'Rossi' in the Athlete field or 'CMJ' in the Test field) or press 🔍 to display a list of athletes or tests to choose from. Similarly it is possible to filter by data by inserting a range of data with the calendar control.

To view all the tests and reset the various filters, press <Delete filter>.

Test List

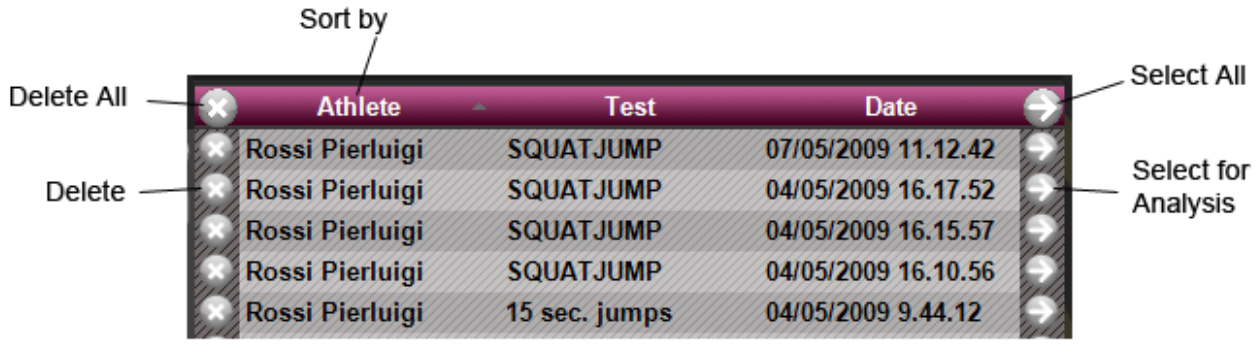


Figure 49 – Test List Components

Click on the column names (Athlete, Test, Data) to display the list in order according to that field. Press again to reverse the order (A…Z, Z…A).

To delete a test, press the ⊗ symbol on the corresponding line of the chosen test; to delete all displayed tests press ⊗ on the table heading.

To select a test to analyze press the symbol → on the corresponding line (or double-click with the mouse): the test will be moved from the LIST table to the ANALYSIS table and a filter will automatically be set on the type of test (e.g. if a 'Squat Jump' test is chosen, the Test List is filtered in order to contain only 'Jump tests'; this allows the user to choose only tests of the same type to submit to 'Comparison').

To add all displayed tests press → on the table heading.

To make multiple selections, use the **SHIFT** key to select a range of athletes (from… to…) or the **CTRL** key for selections that are not adjacent, as explained in section 5.1.2. Pressing → will move only the selected tests. Pressing ⊗ will delete those lines.

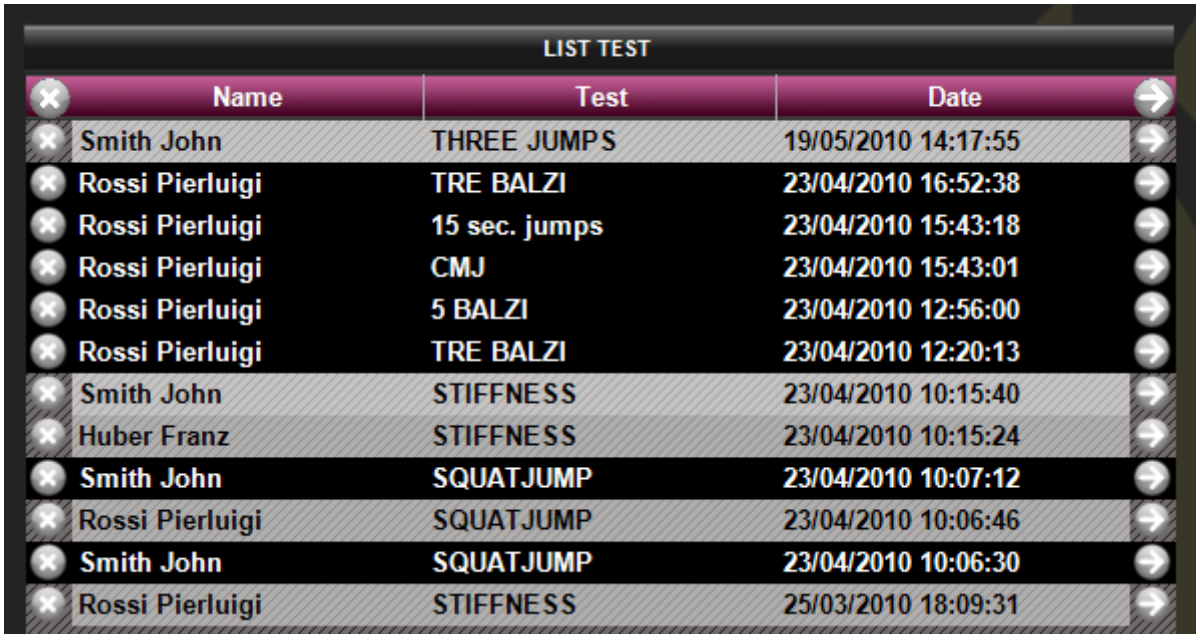

LIST TEST
Name
Test
Date
Smith John THREE JUMPS 19/05/2010 14:17:55
Rossi Pierluigi TRE BALZI 23/04/2010 16:52:38
Rossi Pierluigi 15 sec. jumps 23/04/2010 15:43:18
Rossi Pierluigi CMJ 23/04/2010 15:43:01
Rossi Pierluigi 5 BALZI 23/04/2010 12:56:00
Rossi Pierluigi TRE BALZI 23/04/2010 12:20:13
Smith John STIFFNESS 23/04/2010 10:15:40
Huber Franz STIFFNESS 23/04/2010 10:15:24
Smith John SQUATJUMP 23/04/2010 10:07:12
Rossi Pierluigi SQUATJUMP 23/04/2010 10:06:46
Smith John SQUATJUMP 23/04/2010 10:06:30
Rossi Pierluigi STIFFNESS 25/03/2010 18:09:31

Figure 50 – Multiple selection

From the test list it is possible to perform two operations by **RIGHT CLICKING** on one test line. More precisely:

- **Change person**: allows to associate a test with another person, if the wrong association was made during execution; select the command and choose an athlete from the displayed mask; press <Confirm> to choose the new person
- **Edit note**: allows to view/edit the note inserted immediately after test completion; the note will be printed on the report in the General Data section on the first page of the test

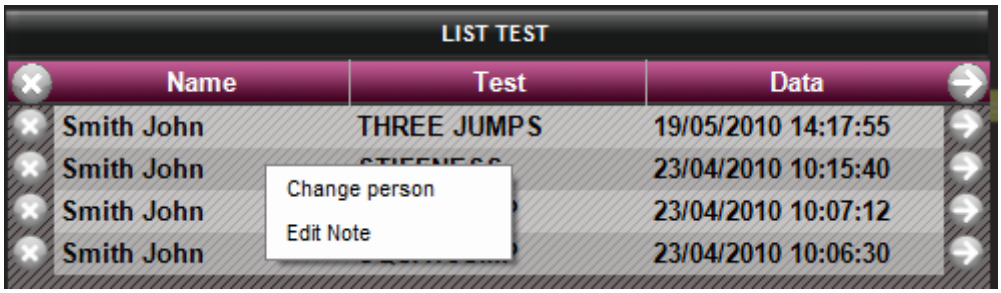


Figure 51 – Context menu under a single test

If you right-click on Analysis List you can:

- **Rename**: allows to rename the analysis
- **Analsysis Notes**: allows to view/edit the note that is printed at the bottom of the report

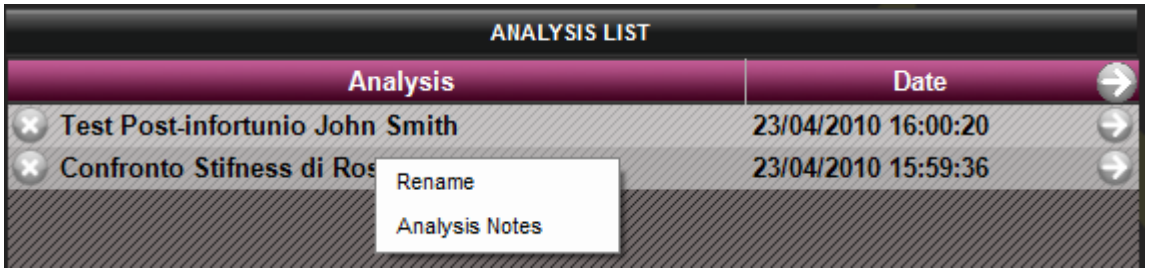


Figure 52 - Contextual Menu under saved analysis

Test Analysis

To view a single test, select the corresponding line in the 'TEST ANALYSIS' table and press the button <View> (or double-click with the mouse). See chap. 5.3.1 View

To compare two tests, insert the relevant tests in the 'TEST ANALYSIS' table and press the button <Compare>. See chap.0. The button is disabled if the number of tests in the window is less than two.

To remove a test from the analysis, press on the corresponding line in the 'TEST ANALYSIS' table, whereas to delete all the tests displayed press on the table heading.

To analyze the history insert two or more tests in the 'TEST ANALYSIS' table and press the button <History>. See chap.5.3.3.

To export the data to Excel, add at least one test to the 'TEST ANALYSIS' table and press <Export>. A dialog box asks if the extended version (for each data line the test heading and athlete's data are repeated) or the simple version (only numerical test data) should be displayed.

Pressing <Print> n-number of reports in PDF format are generated, the number corresponding to the number of tests shown in the 'Test analysis' window. Before generating the output, the output directory for the above files must be selected.

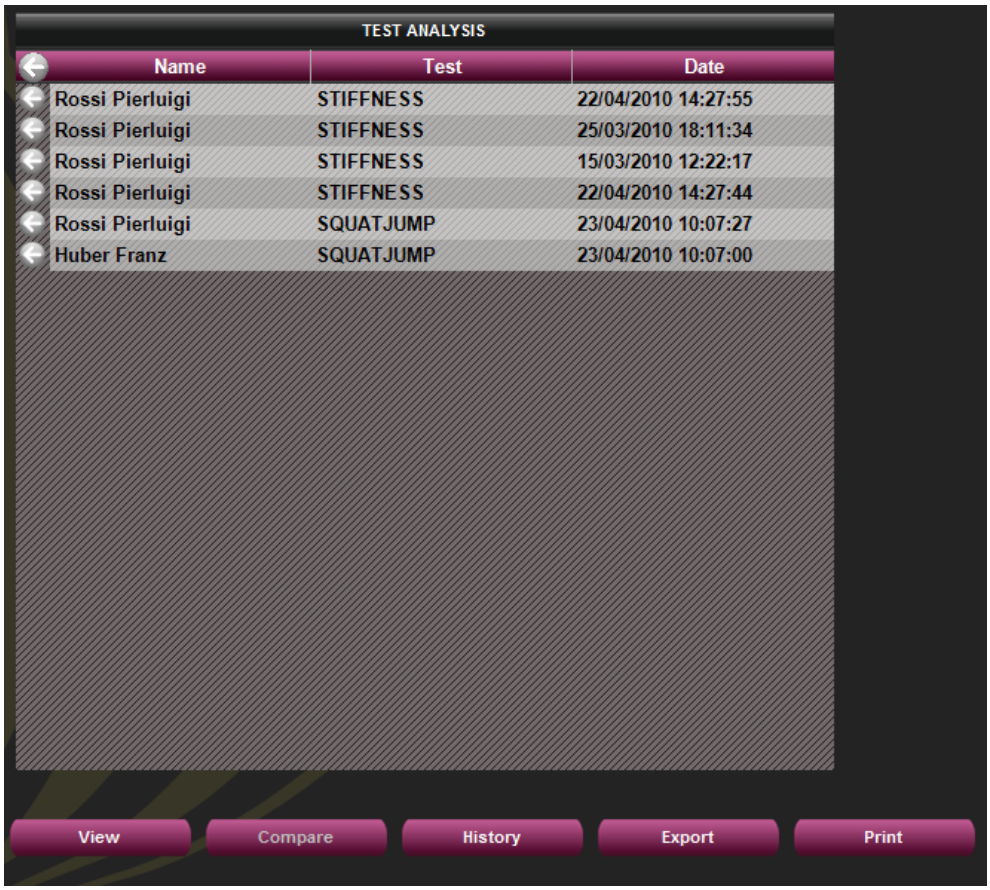


Figure 53 – Test list to analyze

5.3.1 VIEW

In this section the test selected is displayed.

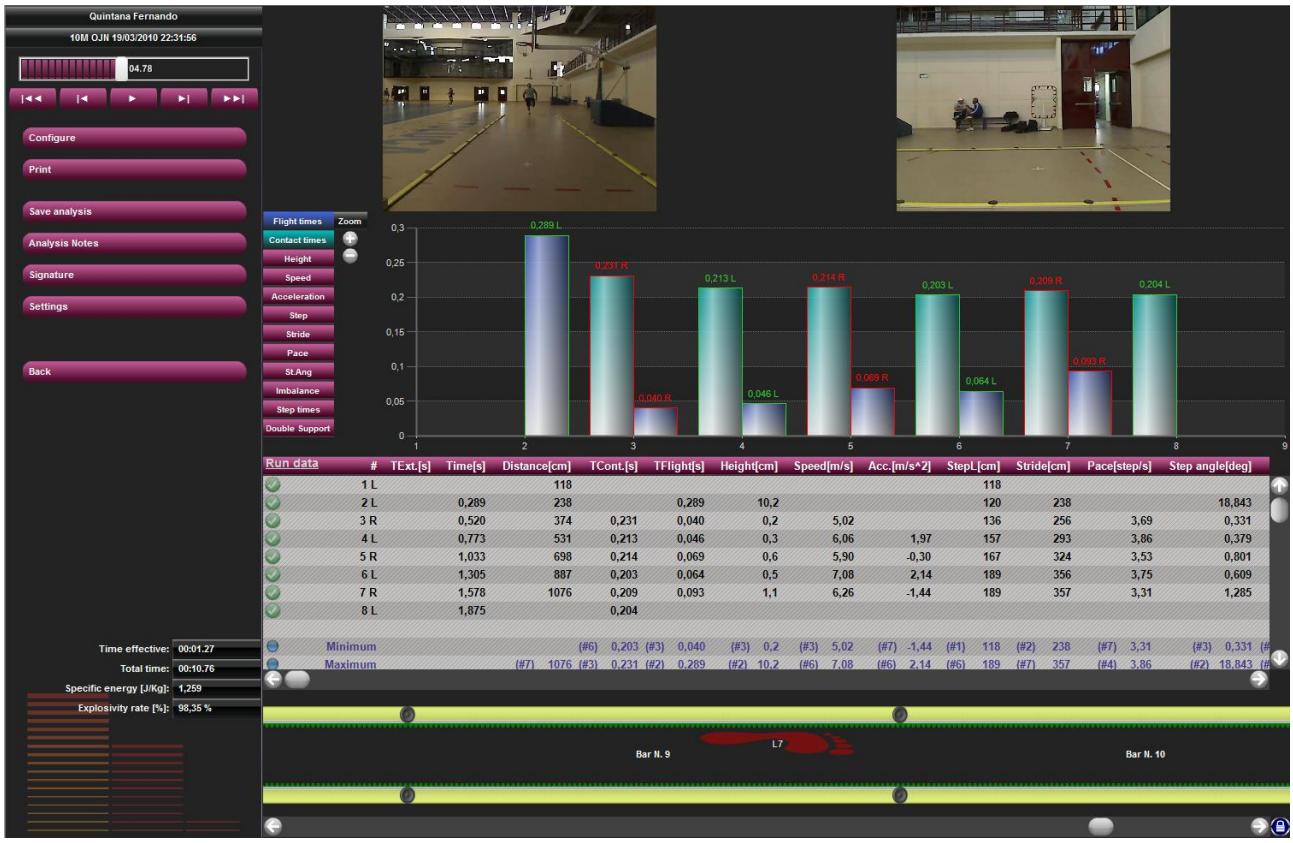


Figure 54 – View

The items on the left from top to bottom are the following:

- name of the athlete
- test type and execution date
- VCR player with slider and commands for managing the acquired video(s)
- command buttons for activating various functions
- <Back> button to close the mask View and go back to the Test list.
- total test data

On the right there are 4 types of information regarding the current test; each set of information can be shown/hidden using the configuration commands.

The items from top to bottom are the following:

- **Videos** acquired by (one or two) webcam(s); if the webcams are not connected when the test is performed, a fixed image with the Microgate logo will appear

- **Charts** displaying the results: it is possible to choose the chart type (lines or bars) and the measurement to be displayed (times, heights, powers, etc.)
- **Table with numerical data**: a grid with various lines and columns displays actually acquired data and calculated data; at the bottom of the table statistical and aggregated data are displayed (average, minimum, maximum, etc.)
- **OptoJump bars**: displays the n-number of bars connected at the time the test is carried out and which LEDs turn on during the test

The table shows the list of all the external, flight and contact times acquired during the test. The data has been processed to obtain further information such as jump heights, energy, developed power, etc. See chap.6.1.

In the case of Sprint/Gait test, step length, speed, and acceleration are also displayed.

By checking the various rows, invalid flight and/or contact times can be deleted. See chap. 6.3

In the bottom left area total test data is displayed, such as:

- **Effective time [mm:ss.dd]**: actual time of the test in the format minutes, seconds and milliseconds; this is the difference between the actual start of the test, calculated from the first event (eg. the first take-off from the ground), and the end of the test.

- **Total time [mm:ss.dd]**: total time of the test in the format minutes, seconds and hundredths of a second; this is the difference between the start of the test, signaled by the acoustic signal, and the end of the test. If, for example, 10 seconds pass between the two start beeps and the end of the test, and the athlete begins to jump 3 seconds after the first beep, the two values will be Total time = 10 and Effective time = 7.

- **Specific energy [J/kg]**: specific energy produced during the test calculated with the following formula:

$$\sum h_{jumps} \cdot g$$

- **Specific power [W/kg]**: specific power expressed during the test calculated with the following formula:

$$\frac{g^2 \cdot \sum T_f \cdot (\sum T_f + \sum T_c)}{4 \cdot n^\circ jumps \cdot \sum T_c}$$

Where T_f = Flight Time, T_c = Contact Time

- **Athlete's weight [kg or lb]:** athlete's weight in kg or pounds
- **Total energy [J]**: if the athlete's weight is available, this field contains the total energy expressed by the athlete during the test (SpecificEnergy * AthleteWeight)
- **Total power [W]**: if the athlete's weight is available, this field contains the total power expressed by the athlete during the test (SpecificPower * AthleteWeight)

At the top left (see figure below) is the command panel for checking test progress.

Figure 55 – Command panel

From left to right the commands available are:

- Back to the start of the test
- Back one frame
- Play/Stop
- Forward one frame
- Forward to the end of the test

Move the progress bar (slider) by moving the cursor with the mouse.

Instead of the buttons Back/Next, the right and left arrow keys on the keyboard can be used to move forward/backward by single frames. Thes CTRL+Right Arrow and CTRL+Left Arrow can be used to move by a thousandth of a second.

5.3.1.1 CONFIGURATION PANEL

Pressing <Configure> displays the choices available.

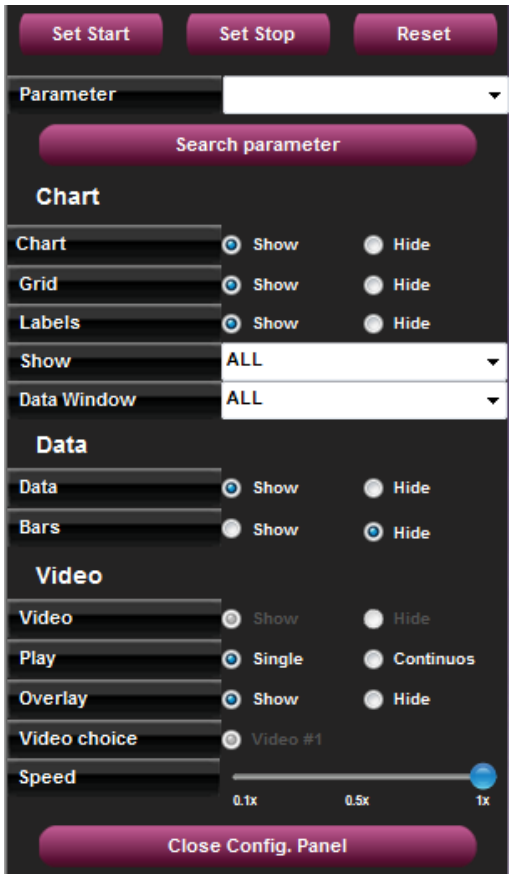


Figure 56 – Configuration Panel for the View test function

The <Set Start>, <Set Stop> buttons are for defining the start and end respectively of the part of interest. Place the cursor at the start and finish points of the desired movie clip and press <Set Start> and then <Set Stop>. Thus a part of the movie clip is isolated, deleting the uninteresting 'dead' periods.

Press <Reset> to cancel the 'Start' and 'Stop' references and restore them to their initial values.

Double-clicking anywhere on the timeline, the positioning time can be entered. The value must be in milliseconds (i.e. for example 1906 to reach 19".06)

With <Search Parameters> it is possible to look for a parameter selected from the 'Parameter' drop-down menu; e.g. select 'first flight time' and press Parameter Search: you will see the film clip and the slider go forward to the frame corresponding to the athlete's first take-off from the ground. By using 'Next T.Flight', you will go forward to the next corresponding event. This function is very useful when comparing two tests.

The display of test data can be configured by the user:

- Chart
  - **Chart**: shows/hides the chart
  - **Grid**: shows/hides the dotted lines forming a grid on the chart
  - **Labels**: shows/hides the labels for the numerical values of the times on the chart
  - **View**: shows all the data acquired or only certain data; in this case a scrollbar allows to move to the right and left inside the chart
  - **Data Window**: in the table of numerical data displays only the n-number of data based on the window in blue shown in the chart. To move the window, right-click it with the mouse and drag it onto the chart.

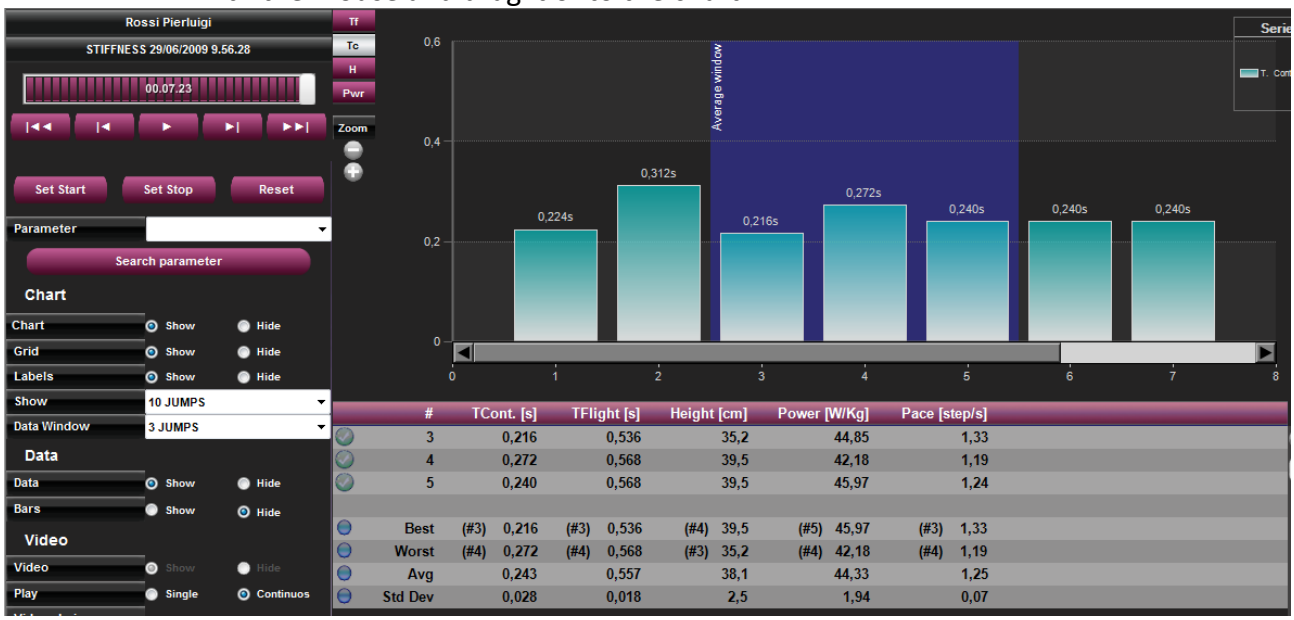


Figure 57 – Display 10 events at a time and take 3 of them into consideration (blue window)

- Data
  - **Data**: shows/hides the grid with numerical data
  - **Bars**: shows/hides the OptoJump Next bars
- Video
  - **Video**: shows/hides the acquired video
  - **Play**: you can play 'Single' (only once) or 'Continuous' (looping the test)
  - **Overlay**: using graphical tools draw on a still picture and save this image as an overlay ( ); use this flag to show or hide it
  - **Video choice**: Allows to choose whether to show or hide one of the two videos
  - **Speed**: sets the playing speed: normal (1x) or slowed down by a factor from 0.1x to 0.9x

The Configuration panel can be closed (i.e. minimized) using the button **<<** in the upper left corner. Only the video commands (play, stop, ff-fw, rew, etc.) are available, allowing to view the test. Use **>>** to open again the panel**.**

Figure 58 – Open Configuration panel

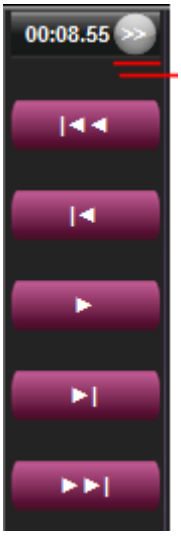


Figure 59 – Closed Configuration panel

5.3.1.2 CHARTS

In OptoJump Next charts there are usually some possible viewing possibilities. (e.g. in Figure 10 'Flight times' and 'Contact times' are displayed). To change view type just left-click with the mouse on another option (such as 'Power' or 'Height'). The buttons have the same colors as the chart bars/lines and are therefore used as legend.

In addition, if you place your cursor on one of the buttons, the displayed chart type will appear on the right. It can be lines ( ) or bars ( ). To change the chart type just left-click with the mouse on the corresponding symbol.

By pressing the symbols under 'Zoom' you can increase (⊕) or reduce (⊖) the chart display.

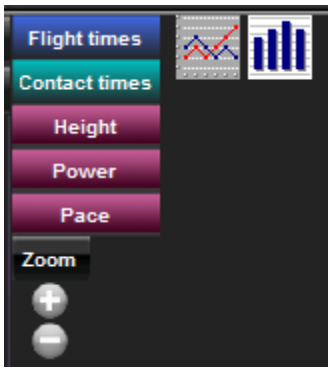


Figure 60 – Chart options

If a setting is not available it is displayed in black, e.g. if no second webcam is connected, the option 'View video#2' is disabled.

The OptoJump Next software has a graphic tool for analyzing images acquired by webcams. To enter this section, just double-click with the mouse on the still picture to process (see chap. 6.4).

Press <Close Config Panel> to close the Configuration panel.

5.3.1.3 TABLE WITH NUMERICAL DATA

In 'Jump Tests' or 'Reaction Tests', the numerical data to display are few and therefore almost always fit into one screen.

In Spring/Gait Tests (regular or with treadmill), on the contrary, the numerical data have many columns (a horizontal scrollbar is shown); therefore it has been decided to divide them into two pages: the first with the *Run Data* and the second with the *Gait Data*.

To switch from one screen to another, click on the link on the top left corner of the table.

Run data	#	TExt.[s]	Time[s]	Distance[cm]
	1 L			118
	2 L		0,289	238
	3 R		0,520	374
	4 L		0,773	531
	5 R		1,033	698
	6 L		1,305	887
	7 R		1,578	1076

Gait data	#	TExt.[s]	Stance phase[s]	%
	1 R			
	2 R		0,231	
	3 L		0,213	
	4 R		0,214	
	5 L		0,203	
	6 R		0,209	
	7 L		0,204	

Figure 61 - Run & Gait Data

In Tapping Tests, four pages may be scrolled:

- Left and right foot results
- Left foot results
- Right foot results
- Comparison between right and left foot

In the Run Test (on a modular system or on a treadmill) there is another possibility, i.e. to view a dynamic report (**Run Report**) focusing on the asymmetry between the right and the left foot. Of course, the report can be viewed also under Results and in the print report. To view the report, click on the link highlighted in the upper left corner to toggle between Run Data, Gait Data, and Run Report

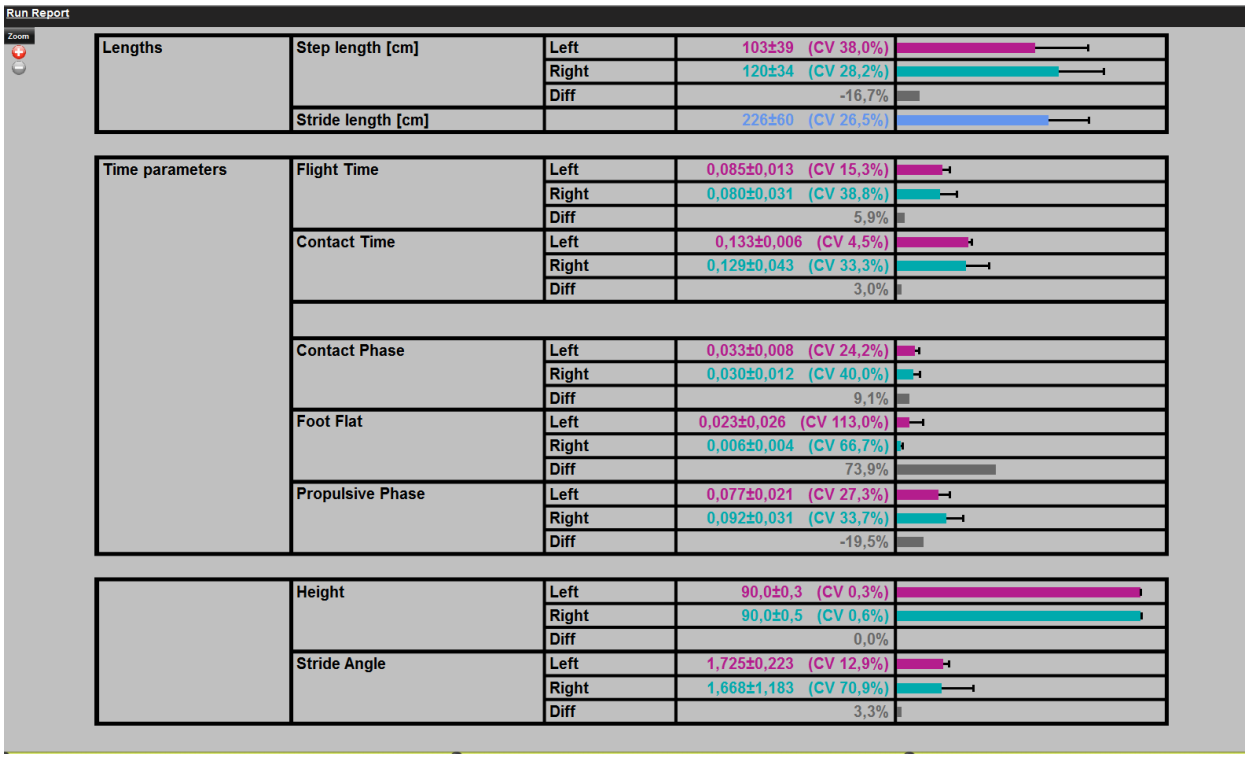


Figure 62 - Run Report

At the bottom of the data, some statistical data are calculated:

- Minimum Value
- Maximum Value
- Average (μ)
- Standard Deviation (σ)
- Coefficient of Variation (CV: ratio of the standard deviation to the mean)

In some test type, values are calculated for each foot (left & right)

Minimum	(#24)	0,062	(#8)	0,374	(#8)	17,2	(#8)	20,94	(#2)	1,33
Maximum	(#8)	0,282	(#22)	0,579	(#22)	41,1	(#22)	107,27	(#12)	1,78
Avg		0,184		0,459		26,2		41,10		1,56
Std Dev		0,051		0,057		10,0		20,45		0,10
CV		27,7%		12,4%		33,3%		49,8%		6,4%
Avg L		0,189		0,464		30,0		40,16		1,56
Avg R		0,180		0,455		30,0		42,05		1,56
L - R(%)		4,8%		1,9%		0,0%		-4,7%		0,0%
CV L		18,5%		12,7%		33,3%		45,8%		5,8%
CV R		35,6%		12,5%		33,3%		55,1%		7,1%

Figure 63 – Calculated statistical data

5.3.1.3.1 Row Management Menu

When RIGHT-clicking with the mouse on a table row a context menu appears with the following items:

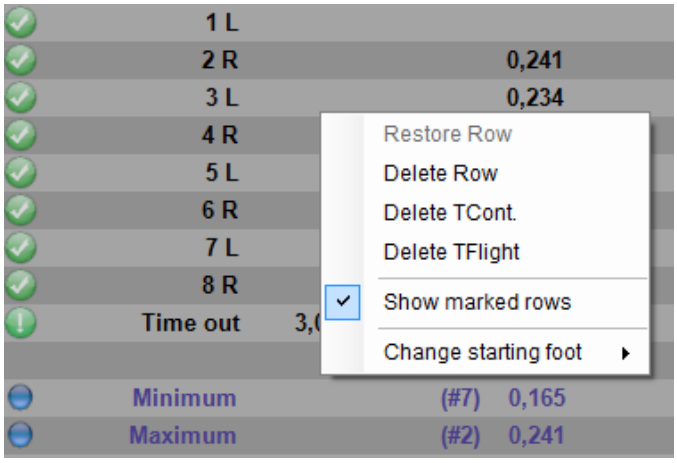


Figure 64 – Data row management menu

- **Restore row**: allows to reset a previously deleted row or a row connected to the row above or below as valid
- **Delete row**: deletes the selected row – deleted rows are not considered in the calculation of averages and of total values for the test and are displayed in ~~strikethrough~~ syle
- **Delete TCont.** deletes a contact time from the selected row; as a consequence the associated contact and flight times are added to the flight time in the row above
- **Delete TFlight:** deletes the flight time from the line row; as a consequence associated flight and contact times are added to the contact time in the row below
- **Show marked rows**: allows to show/hide deleted rows or rows with deleted flight or contact time
- **Change starting foot**: allows to set the right foot or the left foot as starting foot. It is very useful to use the video to discern with which foot the athlete has started. If you do not have video recordings and you do not remember the foot, specify 'Undefined'.

5.3.1.4 START FOOT

The Starting Foot can be defined during the creation of a test (see 'Define / Modify Test'), or afterward - keeping it as 'not defined' - during the analysis.

Sprint and Gait Test on modular systems:

- Starting outside the test area: the starting foot is *the first one to touch the ground inside the area;*
- Starting inside the test area: the starting foot is *the one with the first contact after the beginning of the test.*

Assigning the starting foot after a test has been carried out is done in the 'Results' area. From 'View', open the 'Configure' menu, select 'First Contact Time' from 'Parameter Research' and, viewing the first contact time from the 'Data' window, right-click on the relevant line. At this point, select 'Change starting foot' from the displayed menu and make your choice.

e.g. In the following picture the athlete enters the Optojump test area with his RIGHT foot (as you can see in the video) and then, using the menu, it is possible to assign that foot (confirmed by the green footprint below).

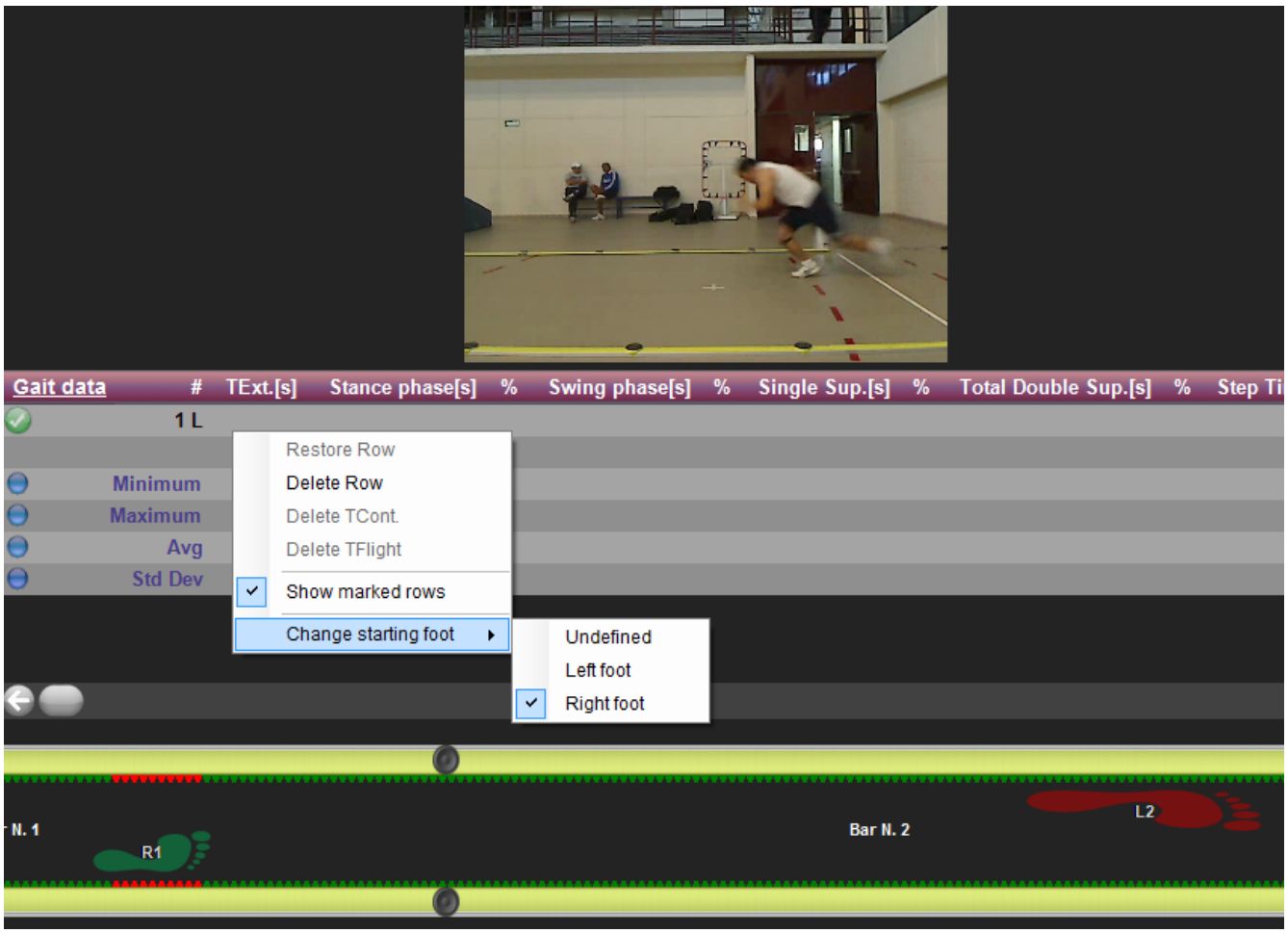


Figure 65 – Sprint and Gait Test: assigning the starting foot

Should you realize that the assigned starting foot is wrong, just follow the above-stated procedure and switch the selection.

Treadmill Running Test and **Treadmill Gait Test.**

In this case the foot touching the ground *after* the START command is assigned as starting foot.

If the START is assigned during a double support, as occurs quite often in Gait Tests, the starting foot is the one *in front* on the Treadmill.

Figure 66 - Defining the starting foot = right foot, pressing START at this moment

Of course it is possible to do this afterwards using the same method described above for the **Sprint and Gait Tests on modular systems** (even as regards possible foot assigning errors).

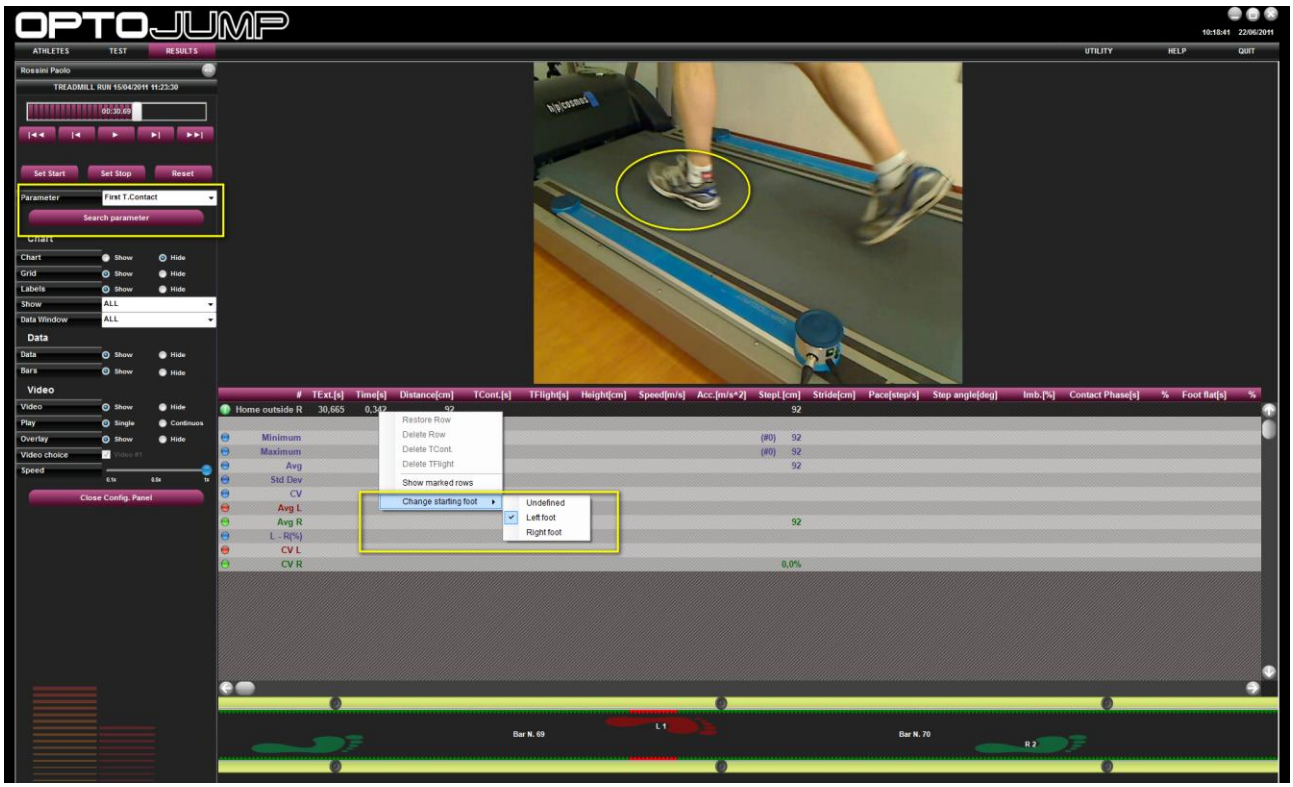


*Figure 67 - Treadmill **Running** Test: assigning the starting foot*

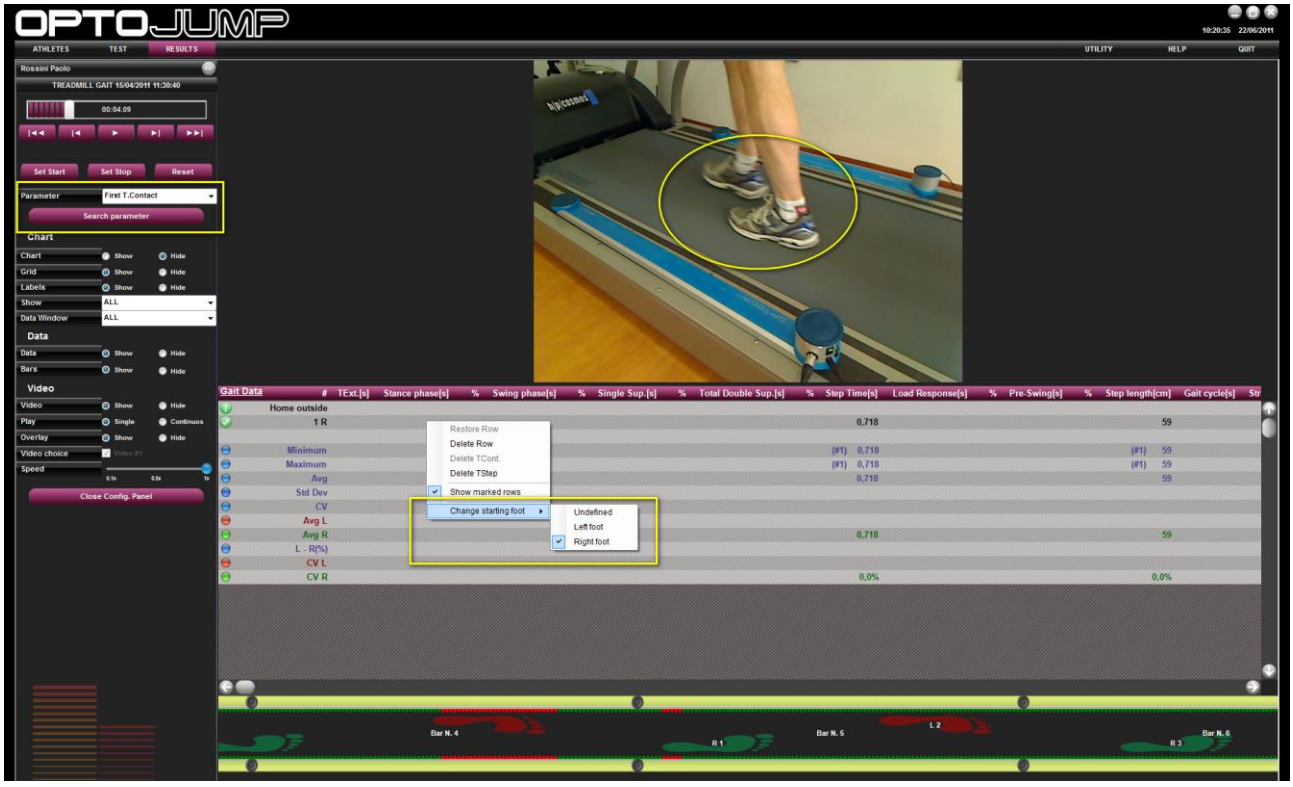
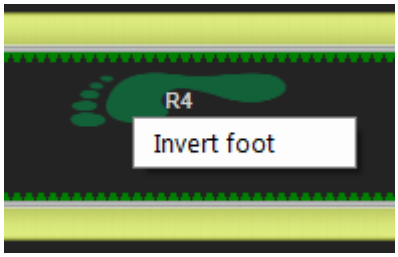
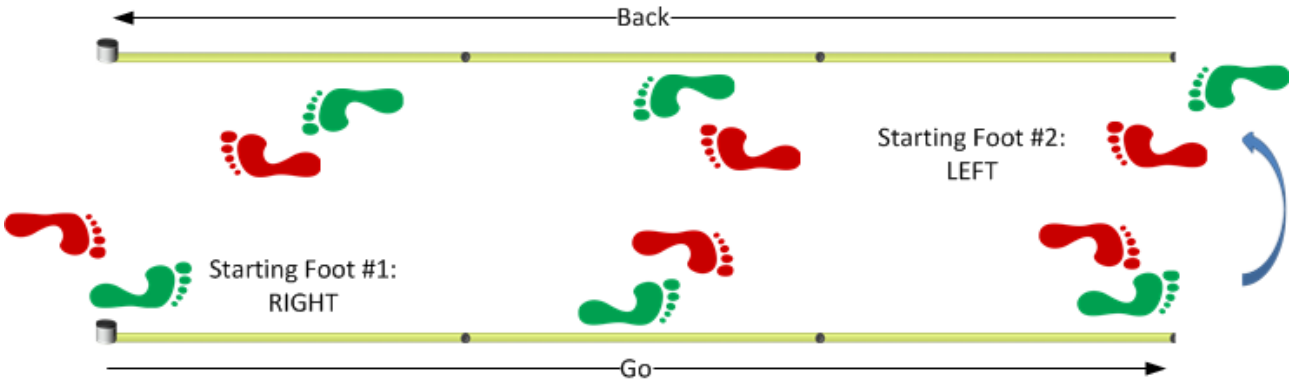


*Figure 68 - Treadmill **Gait** Test: assigning the starting foot (double support)*

The starting foot of run and gait tests with modular systems can be change several times. In a round-trip test, for example, it can be useful to change the foot with which the athlete has entered the area after having changed direction. By positioning the mouse on the footprint to be changed and pressing the right button 'Invert foot' is viewed. Choosing this option, all following feet of the chosen foot are changed (e.g. clicking on the footprint #7, the 7,8,9, etc. are inverted.).





In the round-trip used in modular systems, assigning a maximum flight time **lower than** the time it takes the athlete to turn around in the test area, the 'there' footprints are deleted and substituted with the 'back' footprints. Therefore, set the maximum flight time based upon one's needs (i.e. if the 'there' and 'back' footprints are to be left superposed as shown in the figure, or the previous ones deleted).

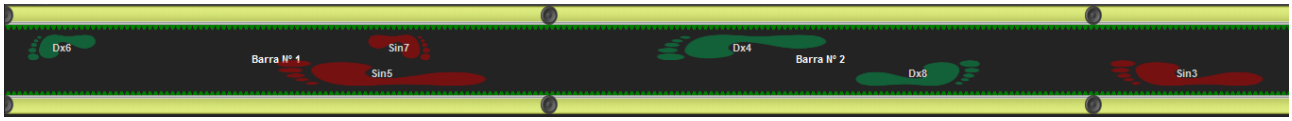


Figure 69 - There' and 'Back' footprints

5.3.1.5 VIEWING OF THE OPTOJUMP BARS

The OptoJump bars allows the user to view afterwards the LEDs that have been interrupted (in red) and, if a starting foot has been set, view the footfall thanks to the graphical footprints. The footprint length is directly proportional to the number of interrupted LEDs.

Similarly, the labels of the numerical data chart and row values always display which foot they are referring to.

Figure 70 – Indicating the foot on charts, tables and bars

When watching a run/gait video of a modular system composed of many meters, as the time progresses, the bars scroll in synchronization with the video and the charts, allowing the user to follow the LEDs interrupted during the test.

Bar scrolling can be disabled by clicking on the lock icon in the bottom right corner. The button has a toggle function, so when clicked scrolling is enabled again.

From this view a '**Measuring Ruler**' can been used to see how many centimeters (or inches) there are between a series of lit LEDs (or between two points). Double-click on the first LED and then on

the second LED to view the measure (the markers are green and red for the first and second point). Click anywhere on the bars and ESC to delete the measure.

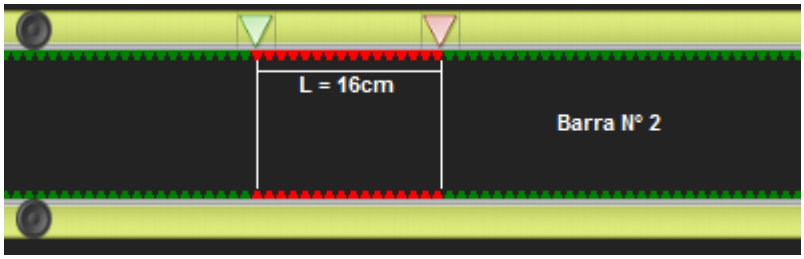


Figure 71 - Measure in cm or inches of the distance between two points

In this view you can also **temporarily delete a series of LEDs for a certain period of time**. Unlike the command <LED Filter> (see chap. 5.4.3), which excludes a series of LEDs for the entire test, this allows you to work also during the test analysis and exclude a series of contiguous LEDs (or one single LED) for a certain number of thousandths of seconds. Let's suppose that an athlete drags his foot during a treadmill gait test. If you want to delete the series of LEDs for those 2 seconds, press and hold down CTRL and click on the first wrong LED and (without releasing the CTRL and mouse keys) drag it to the second LED of the segment (a red area indicates the portion to delete). Confirm by pressing YES when prompted, if you want to delete the LEDs, and indicate the number of thousandths of seconds for which the change is to be applied (in this example 2000), and the numeric data table will be displayed. If you want to save the data, press <OK> in the upper left corner. Otherwise, press <CANCEL>.

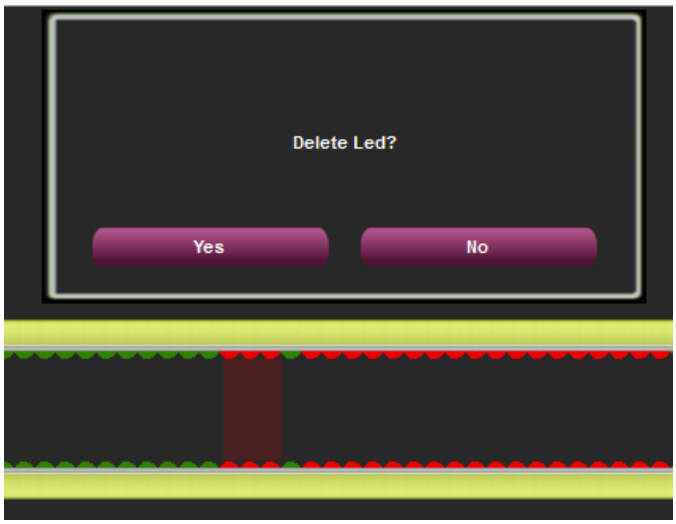


Figure 72 – Deleting LEDs for a certain amount of time

If you want to delete the whole series of LEDs (a complete footprint) for the entire test, press CTRL+right mouse click on any red LED of the footprint and then confirm the deletion pressing YES.

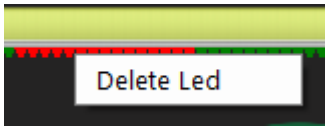


Figure 73 - CTRL-Right Click: delete whole footprint

5.3.1.6 PRINT

When <Print> is pressed, a multi-page report is printed with the athlete's data, summarizing (average) test data, numerical test data (times, heights, power, etc.) and all the charts of the previous window.

A box containing the index with the pages allows you (by clicking on each page) to rapidly select the desired section.

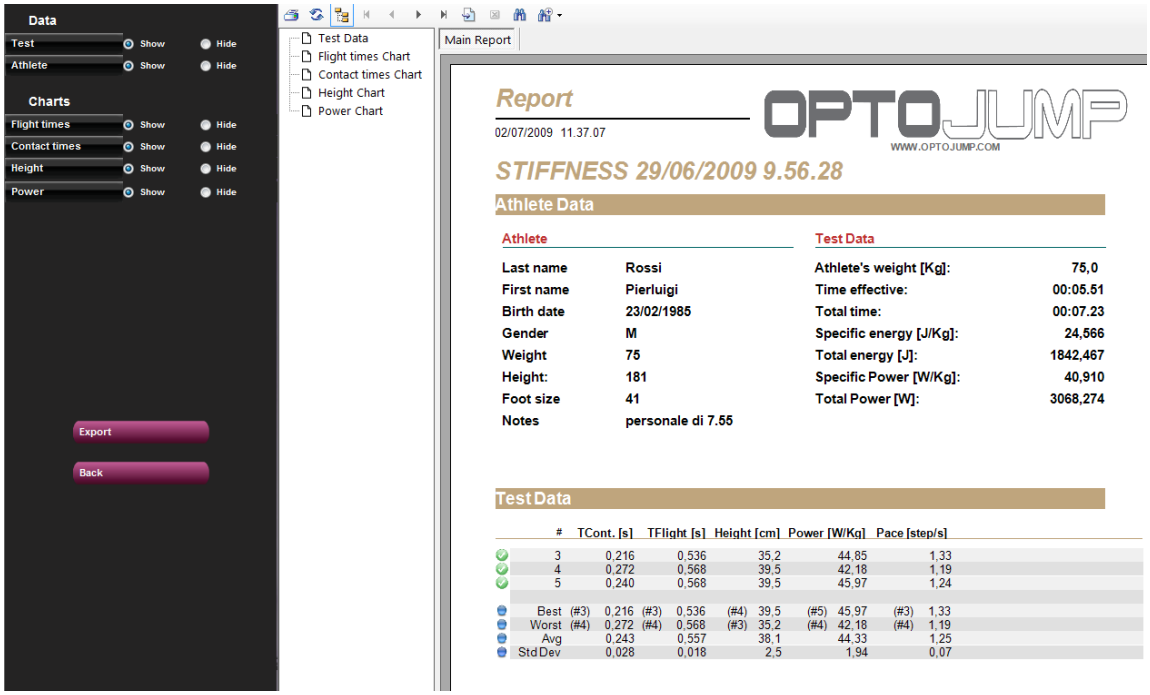


Figure 74 – Report Print

The radio buttons on the left allow you to show or hide particular sections of the report for both Data and Charts.

The command toolbar above the report allows you to perform the following operations:

Figure 75 –Print Report Command Toolbar

- **Print** the report on the printer set in the dialog box
- **Refresh** the data
- **Show/Hide** the page index
- Go to **first** page
- Go to **previous** page
- Go to **next** page
- Go to **last** page
- Go to page **No.**
- **Close** the report
- **Search**
- **Zoom**

The buttons **<Change logo>** and **<Change footer>** allow you to customize the report adding your logo and your personal data (respectively printed in the top right corner and on the bottom line).

Press **<Export>** on the left to export the report in PDF, Excel, Word or Html format.

Choose the desired format from the drop-down menu, select the position, name the file, and then press 'Save'.

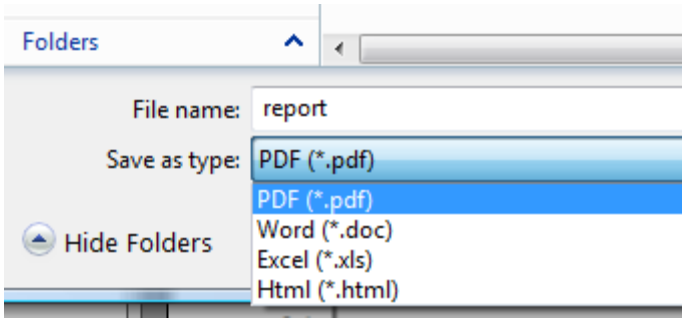


Figure 76 – Dialog box for saving a report

The functionality of Report creation, printing and saving are offered by the external Crystal Report component. If this does not work correctly, we advise you to check whether you have installed different versions or editions of this software. If you have, uninstall the old versions and re-install the OptoJump Next packet.

5.3.1.7 SAVE ANALYSIS

This function allows you to give the current settings configuration a mnemonic name, so that it can be recalled from the list of saved analyses for future use.

5.3.1.8 ANALYSIS NOTES

This function allows you to add a note, which will be saved with the analysis. This note (DIFFERENT from a note added immediately after completing the test) will be printed on the bottom line of the report in the provided section, whereas the 'test note' is printed on the first page with the General Data. Warning: the analysis note is saved with the analysis; by not storing it you will lose it.

5.3.1.9 SIGNATURE

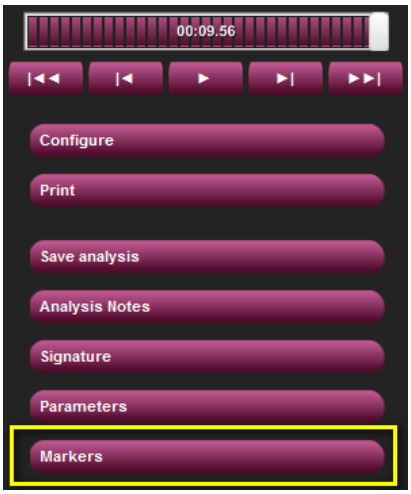
The signature works in a way similar to the notes (e.g. *'Mario Rossi, trainer'*). The signature is printed on the bottom line of the report and saved with the analysis.

5.3.1.10 PARAMETERS

As explained in chap.5.2.2.1, secondary parameters can be customized for each test based on specific needs.

5.3.1.11 USING MARKERS

In a test analysis, other markers besides Set Start and Set Stop can be added in certain spots of the video associating them to a note or a comment. The marker list (which can be created, edited and deleted freely) is also printed in the report showing minutes and comments.



Press the <Markers> button from the menu to the left of the screen.

Set the video to the required frame (using the arrow or CTRL+arrow keys) and press the button <New Marker>; in the pop-up, add a note or a comment for the instant marked by the marker.

In the list below a new record with minutes and the added note is created.

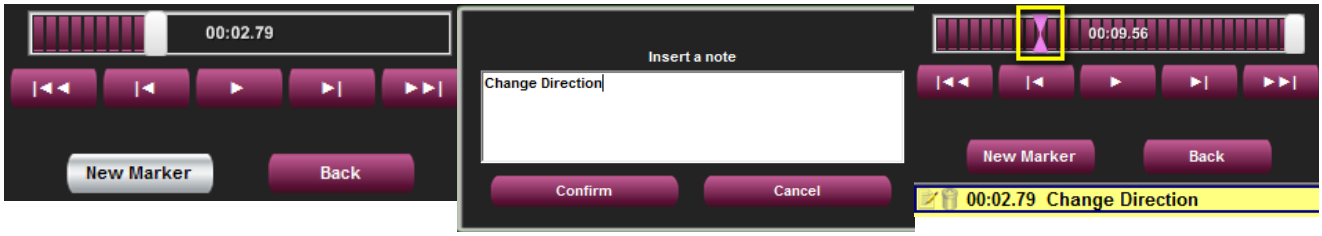


Figure 77 - Creation of a new marker

N markers can be created and managed from the list containing them; in particular you can:

- double-click on one of them to skip to the marker time frame;
- click on the first icon (Edit) to edit the note;
- click on the second icon (Delete) to delete the marker (must be confirmed).

The list is printed in an appropriate Report section.

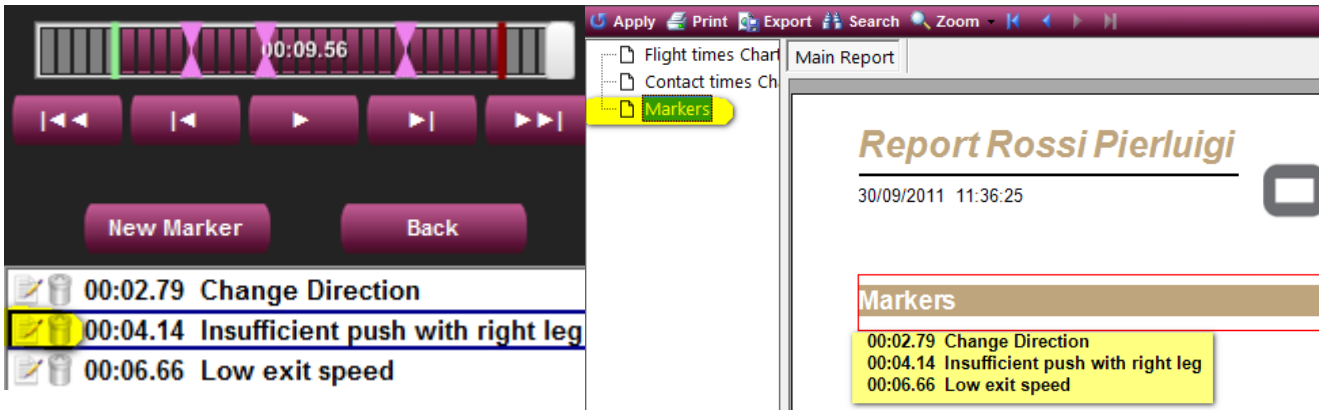


Figure 78 – Marker options

Figure 79 – Report print

5.3.2 COMPARE

In this section two selected tests are compared. The display structure is similar to the one presented in the previous section. Due to lack of space it is not possible to simulate the bars with the LEDs, which is possible when viewing a single test.

To compare two tests, bring them together in the TEST ANALYSIS table and press <Compare>.

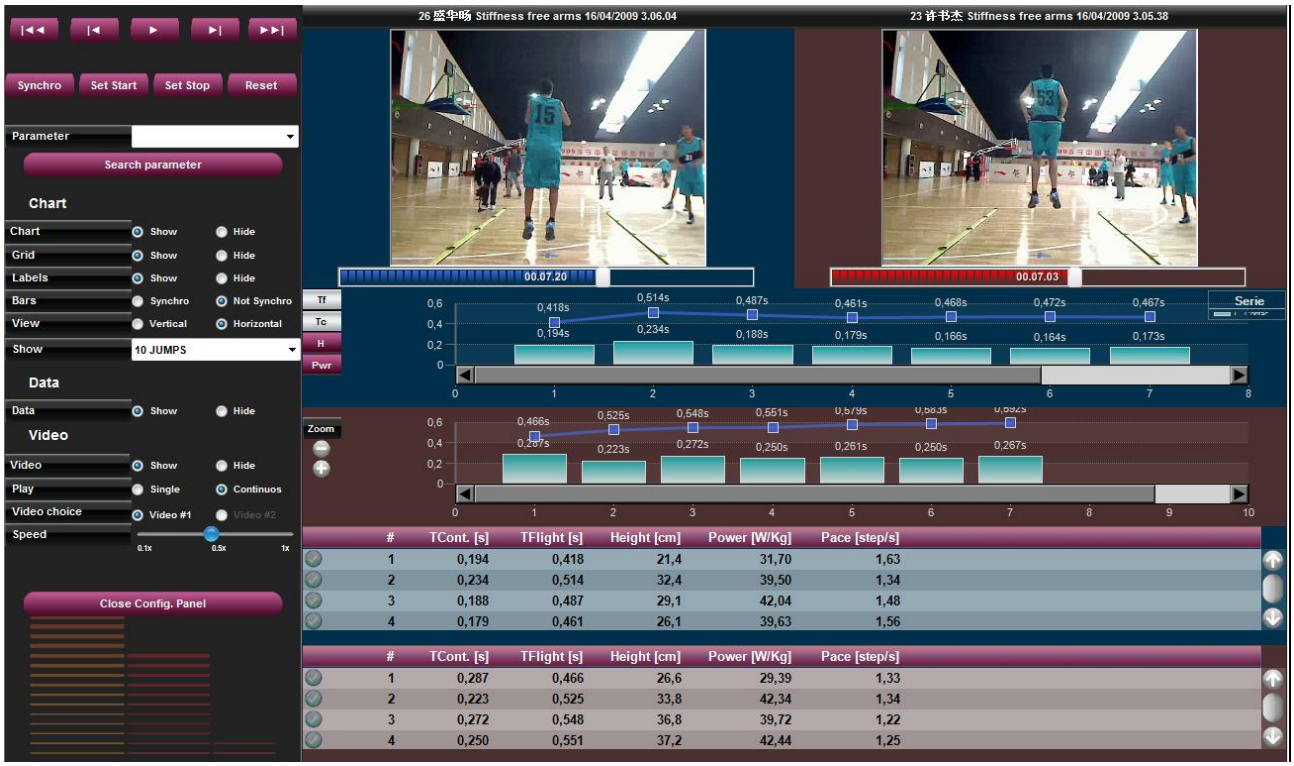


Figure 80 – Compare

Pressing <Play> on the command panel at the top, the two tests (in this example 'Blue Test' and 'Red Test' because of the color of the two sliders below the video) will start running, allowing visual comparison.

The <Configure> button opens an options panel very similar to the one in the previous section (therefore only differences will be described).

The Search Parameter button allows you to spot a common point (e.g. the first take-off from the ground, called First T.Flight) of the two tests.

Besides the above-described commands <Set Start>, <Set Stop>, and <Reset>, there is also the **<Synchro>** command. Press this button to set the point on which the two tests should be synchronized.

For example, search for the First T.Flight with the command <Search Parameter> and press <Synchro>. Move the cursor of both tests slightly backward and press <Set Start>. Move it slightly forward (after the yellow Synchro marker) and press <Set Stop>.

A range to be analyzed has been set and the two tests will be synchronized on the point of the yellow marker (i.e., when the two athletes begin the test).

Another use of the <Synchro> button is to synchronize the two tests on a precise instant (e.g. 10 seconds after the beginning of the test). Set the yellow marker at 10 seconds for both tests; set the start (with <Set Start>) of the Red Test at 6 seconds and of the Blue Test at 8 seconds. Pressing the play button will play the Red Test only until the 8 seconds are over. At that moment the Blue Test will start and the two tests will play in synchronization until the end (or possibly until the point chosen with <Set Stop>).

NB: when you press <Synchro>, <Set Start> or <Set Stop>, make sure you have correctly positioned the two tests at the time chosen, as these actions are applied simultaneously to the two tests.

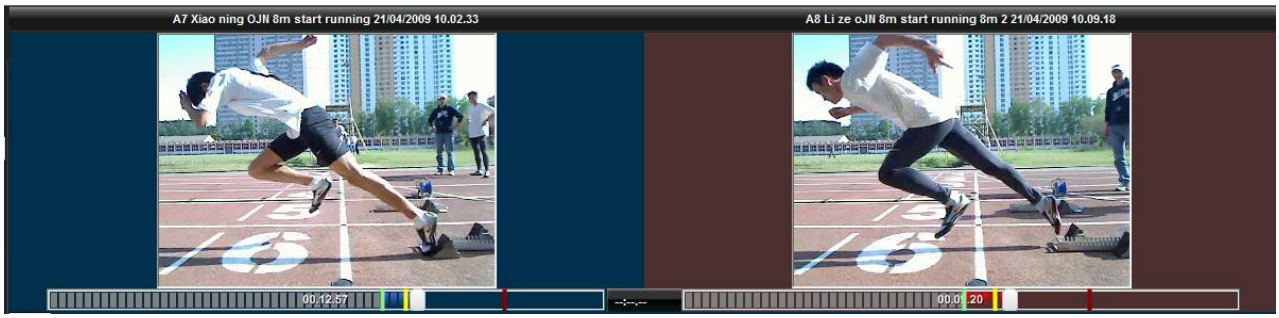


Figure 81 –Synchro, Start, and Stop Settings

Test data viewing can be configured by the user. These settings are similar to those explained in the previous section, except for:

- Chart
  - **View**: data can be viewed horizontally (as in Figure 80 – Compare) or vertically. In the latter case the numerical values are scrolled horizontally.
  - **Bars**: synchronization of the bars means that if, for example, the Blue Test time slider is moved, the red bar for the Red Test time is automatically moved, too. If 'No Synchro' is chosen, the two scroll bars are disconnected and can be moved independently from each other.
- Video
  - **Video choice**: if two movie clips have been acquired (i.e., two webcams are connected), for each test it is possible to choose which movie clip to view, 'Video#1' or 'Video#2'. It is not possible to view the Video taken by Webcam#1 for the Blue Test and that by Webcam#2 for the Red Test (or vice versa).

5.3.2.1 PRINT, ANALYSIS, NOTES, SIGNATURE

The options are mainly the same as those in the 'View' section. Printed data is obviously from the comparison between the two tests. Therefore the name of the test, the values, and charts referred to are always displayed at the top.

5.3.3 HISTORY

The History section allows you to analyze an athlete's progress by graphically and numerically analyzing a series of tests. The section can also be used to analyze the team members, comparing them using the same test type.

Select two or more tests (generally of the same type or uniform in order to ensure plausible data) and press <History>. It is possible to first decide first the sequence with which to view the progress (usually chronological), clicking on one of the column headers (e.g. Date) and then clicking on the <History> button.

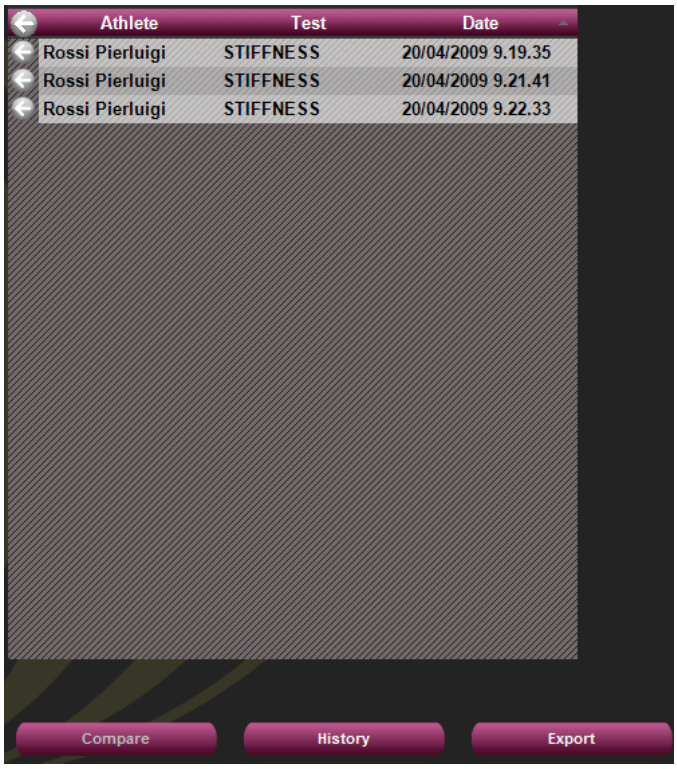


Figure 82 –History analysis of three tests ordered by date

Pressing <Configure> allows you to choose which value to consider for progress analysis: it is possible to select one of the number of jumps or the average, best, worst or standard deviation value.

If the tests had a defined starting foot, it is possible to view the data and progress graphs for only one foot or the difference of both feet.

Clicking on the column headers, data are ordered by measure and the graph is updated. This is very useful, for example, to order the team members from the worst to the best value of any parameter (e.g. from the slowest to the fastest in a 12 m sprint test).

It is possible to use the History module also on a single test (usually a run/gait test where the starting foot has been set), where it is possible to spot asymmetries between the right and left foot using the option 'Diff%'.

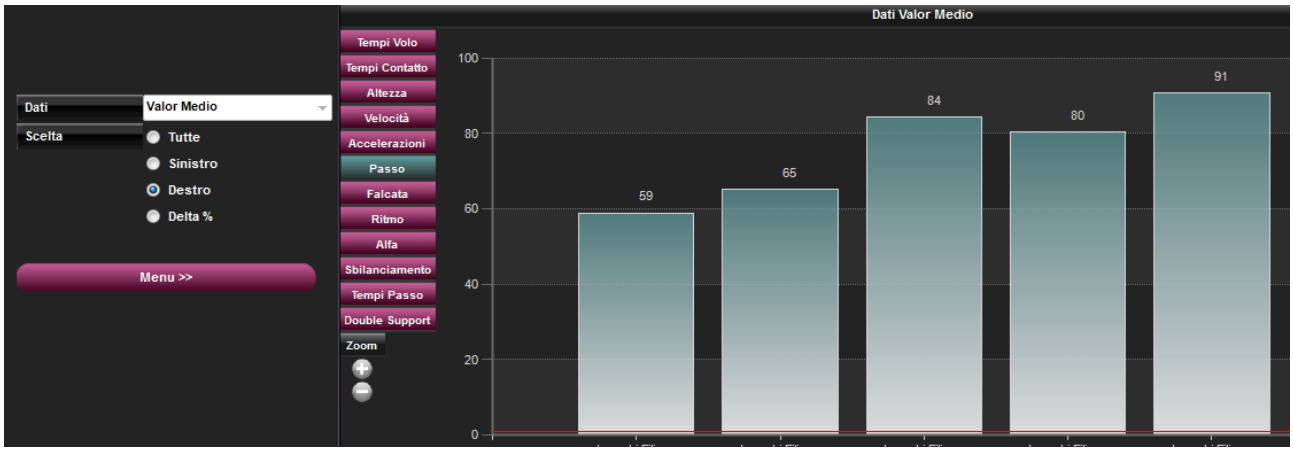


Figure 83 –History of the left foot step length of an athlete

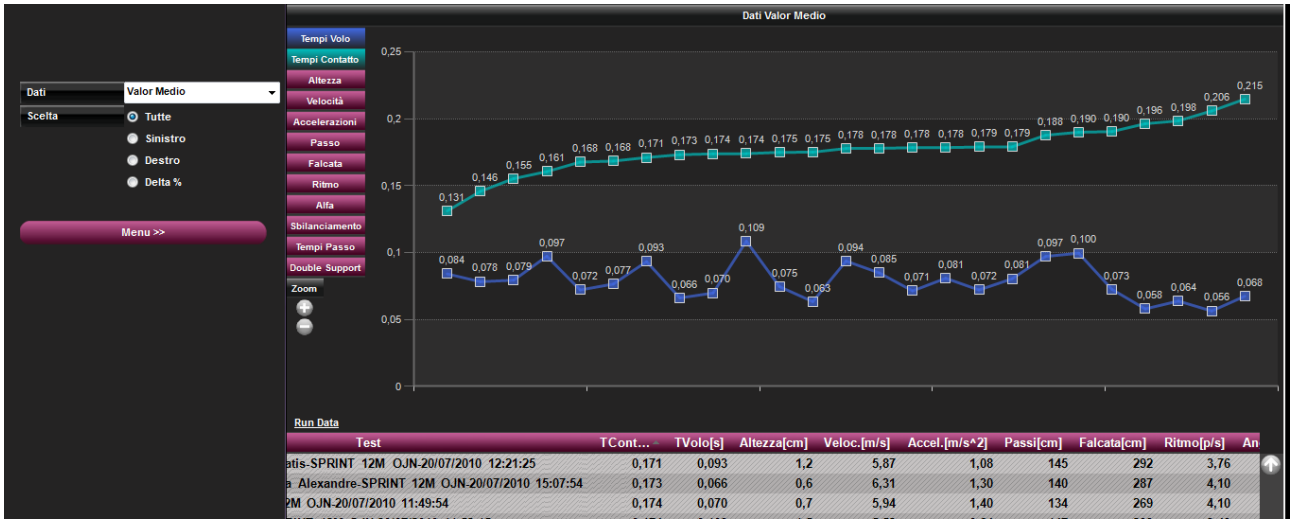


Figure 84 – Team analysis; tests ordered by contact time, from the best to the worst

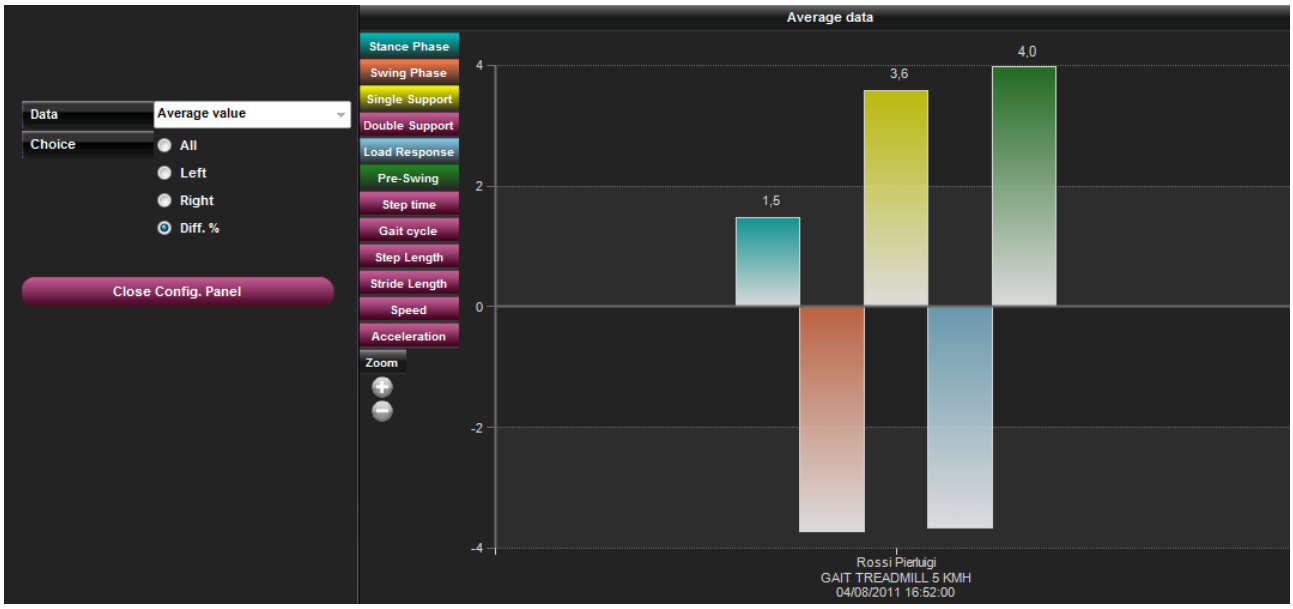


Figura 85 - History of a single test for right/left asymmetries

The <Print> option allows you to create a report to be printed or exported in pdf, Excel, Word or Html format.

5.3.4 EXPORT

To export data of one or more tests to Excel, add at least one test to the 'TEST ANALYSIS' table and press <Export>. You will be asked whether you want the extended version (for each row of data the test heading and the athlete's data is repeated – this is useful for pivot tables) or the simple version (only numerical data for the test).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	Last name	Name	Last & first names	BirthDate	Gender	Weight	Height	Foot	Sport	Discipline	Level	Role	Test	Date	Time	#	L\R	External	TReaction	TWait	TFlight	TContact	TStep	Height	Power	Pace
2	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	1	L									
3	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	2	L				0,058	0,555		0,4	1,54	1,63
4	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	3	R				0,029	1,035		0,1	0,72	0,94
5	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	4	L				0,011	1,225		0	0,27	0,81
6	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	Tf not vaild					0,008	1,173				
7	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	5	R				0,034	1,326		0,1	0,84	0,74
8	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	6	L				0,032	1,143		0,1	0,79	0,85
9	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	7	R				0,02	1,164		0	0,49	0,84
10	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	Tf not vaild					0,007	5,428				
11	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	8	L				0,021	0,462		0,1	0,53	2,07
12	Rossi	Pierluigi	Rossi Pierluigi	23/02/1985	M	75	181	42	Athletics	Long jump		campionati nazionali	SKITEST 15 SEC	16/03/2011	14:13:13	Time out		1,284								
13	Rossini	Paolo	Rossini Paolo	19/08/1983	M	0							SKITEST 15 SEC	15/03/2011	14:50:28	1	L				0,194			4,6		
14	Rossini	Paolo	Rossini Paolo	19/08/1983	M	0							SKITEST 15 SEC	15/03/2011	14:50:28	2	R				0,469	0,107		27	60,76	1,74
15	Rossini	Paolo	Rossini Paolo	19/08/1983	M	0							SKITEST 15 SEC	15/03/2011	14:50:28	3	L				0,221	0,072		6	21,75	3,41
16	Rossini	Paolo	Rossini Paolo	19/08/1983	M	0							SKITEST 15 SEC	15/03/2011	14:50:28	Tc not valid					0,179	0,06		3,9		
17	Rossini	Paolo	Rossini Paolo	19/08/1983	M	0							SKITEST 15 SEC	15/03/2011	14:50:28	4	L				0,22	0,067		5,9	22,56	3,48
18	Rossini	Paolo	Rossini Paolo	19/08/1983	M	0							SKITEST 15 SEC	15/03/2011	14:50:28	Tc not valid					0,158	0,037		3,1		
19	Rossini	Paolo	Rossini Paolo	19/08/1983	M	0							SKITEST 15 SEC	15/03/2011	14:50:28	5	L				0,225	0,065		6,2	24,09	3,45

Figure 86 –Export result in Excel with the Extended version

It is also possible to export ONLY the selected tests in OJN format (a compressed file containing the database as well as video and images). Choose the required tests, press the Export button, and choose the option OJN.

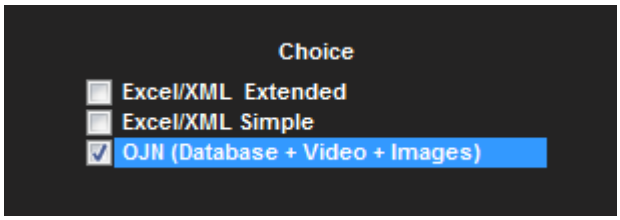


Figure 87 - Export Formats

5.4 UTILITY

5.4.1 BASIC SETTINGS

The Basic Configuration section includes the following items:

5.4.1.1 GENERAL

- **Language**: the language can be changed at any moment during the execution of the program. Select the desired language from the drop-down menu and press <Save>
- **Unit of Measurement**: allows to set the unit of measurement type for viewing test output values. In particular:

Type	International	US/UK
Height	cm	inch.decimal
Power	W	W
Specific power	W/kg	W/kg
Steps	cm	ft, inch.decimal
Speed	m/s	ft/s
Acceleration	m/s^2	ft/s^2
Weight	kg	lb
Energy	J	J
Specific energy	J/kg	J/kg
Distances	cm	yards, ft, inch.decimal
Step & Stride	cm	ft, inch.decimal

Table 1 - Units of Measurement

5.4.1.2 JUMP TEST CONFIGURATION

The flight and contact time configurations include:

- **Minimum contact time [ms]**: allows you to set a minimum contact time in milliseconds; if the system registers a contact time shorter than this value, it is considered incorrect and added to the associated flight time (usually the previous one). This control can be enabled/disabled by inserting the value 0.
- **Minimum flight [ms]**: allows you to set a minimum flight time in milliseconds; if the system registers a flight time shorter than this value, it is considered incorrect and added to the associated contact time. This control can be enabled/disabled by inserting the value 0.
- **Maximum flight time [ms]**: allows you to set a maximum flight time in milliseconds; if the flight time is higher, it is considered incorrect. This is, for example, useful for a

'round trip' test, where the athlete exits the measurement area, turns around and enters it again. The time for changing direction would be considered an abnormal flight time; this parameter allows you to prevent this.

5.4.1.3 Reaction Test Configuration

Reaction time configurations include:

- **Reaction time range [ms]**: indicates the time frame in milliseconds within which the reaction signal must be given randomly.
- **Acoustic signal type**: allows you to choose whether to generate the acoustic signal using the sound card, which may not be present, or the internal loudspeaker generally always available in personal computers.

5.4.1.4 Video

After connecting the webcam(s) to the PC USB port and installing the drivers, the video camera can be tested. Under the heading 'Video', select a Logitech webcam from those available and press <Test>. The choice of webcams has been limited only to high-range Logitech webcams to prevent synchronization problems between OptoJump Next and video data. Webcams by other manufacturers are displayed in gray.

Figure 88

5.4.1.4.1 Video Test

After pressing <Test> the webcam configuration panel in basic mode with the commands for changing gain and exposure (shutter time) is displayed. For better quality and fluidity of videos we recommend using a brief exposure time, such as 1/100 or 1/200, and then adapting gain to obtain the correct image exposure (neither too bright nor too dark). We also recommend not setting 'Auto', which could slow down the movie clip acquisition.

With <Device> you can recall the control panel of the webcam's standard driver. <Default> sets the standard value pre-defined by the manufacturer.

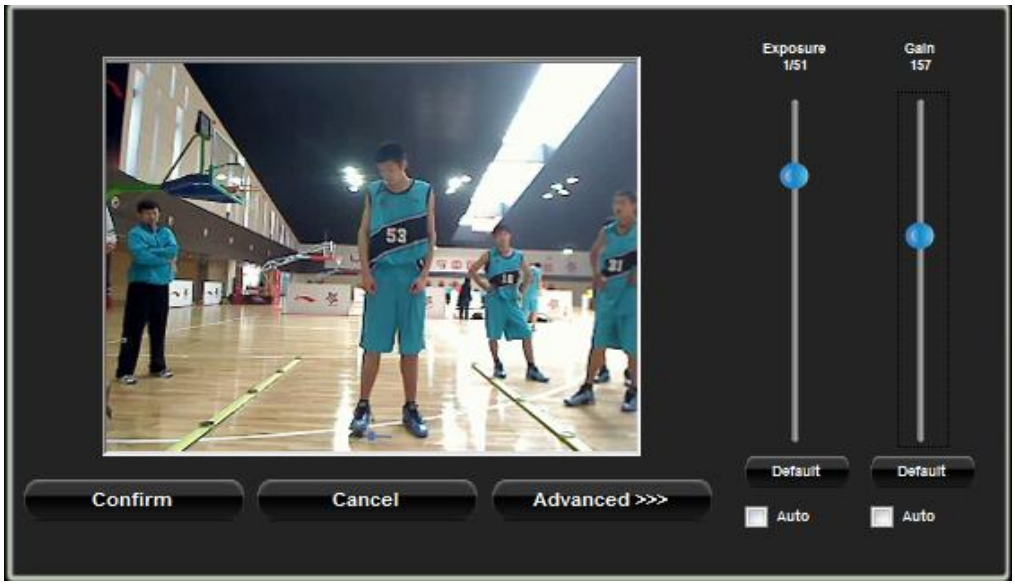


Figure 89– Basic Panel for Webcam configuration

Press the <Advanced> button to display other commands.

- **Zoom** allows you to apply a digital zoom via software.
- **Contrast, Brightness, Saturation, Sharpness** allows you to adapt the image; it is advisable to move the corresponding cursor to test the effects of the command.
- **White Balancing** is useful when working in closed rooms with very warm lights (e.g., tungsten, which gives a yellowish hue) or very cold lights (e.g., neon, which gives a bluish hue). You should frame something neutral (e.g., a sheet of white paper) and remove any dominant colors using the cursor.
- **Focus** allows you to focus manually in those rare cases when the autofocus does not work.

Figure 90– Advanced Panel for Webcam configuration

Remember to save changes by pressing <Confirm>.

Other video-related configurations are:

- **End of time video acquisition [s]**: this is the time between the end of the test and the end of video acquisition (i.e. a certain number of extra seconds are recorded after the end of the test).
- **Acquisition Format**: allows you to choose the format for saving videos, which can be in **ASF** (more compact and compatible with Windows Media Player) or **AVI** (also compatible with other players but less efficient compression).

5.4.1.5 SPRINT/GAIT TEST CONFIGURATION

The configurations of this test type include:

- **Direction of entry**: allows you to indicate if the Running/Gait entry direction is from the 'interface side' (drum) or from the 'opposite side'. If 'automatic' is chosen, OptoJump Next automatically calculates the direction, considering the LED nearest the center of the foot as the beginning of the LEDs.
- **Test timeout [ms]**: this is the test end timeout in milliseconds; if during a test with 'Timeout' stop type no input or output signal is received from the measurement area by the OptoJump device for a period longer than or equal to the time set here, the test is considered completed.
- **External signal holdoff [ms]**: is the holdoff time between two consecutive external signals. Caution has to be applied for this value, because it may depend on the type of test being carried out.
- **Step length calculation**: allows you to choose whether to calculate step length as the distance between the tips of two successive feet or as the distance between the heels of two successive feet.

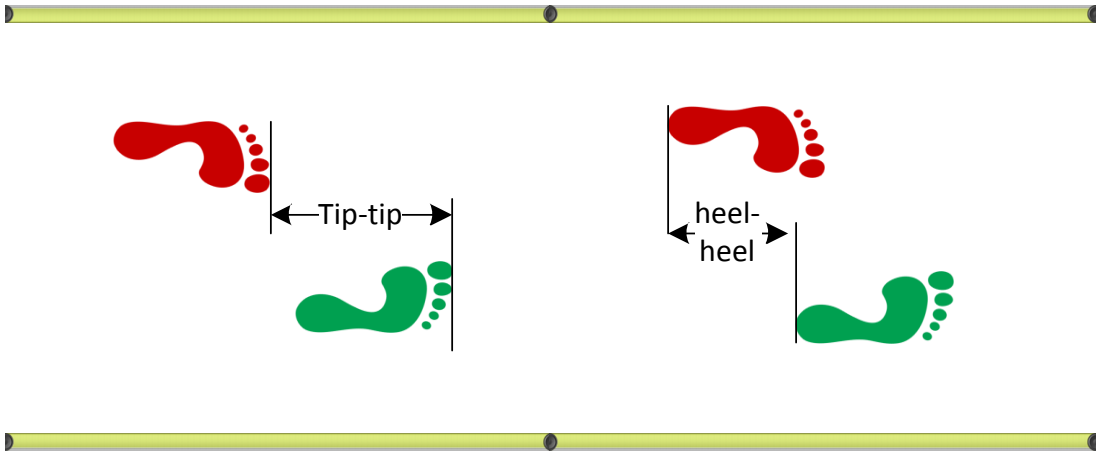


Figure 91 - Tip to Tip or Heel to Heel Step Length

- **Minimum Step Length [cm or ft]**: is the minimum step length in centimeters (or feet), used as a basis to calculate the step length for a Run/Gait test.
- **N° step speed reference:** insert the reference speed for the 3rd / 6th / 9th step in m/s; insert 0 to disable this option.
- **Split N° at distance [cm or ft]**: insert at how many cm from the start the first or second split time will be taken; leave 0 to disable split times.
- **Minimum foot length [cm]**: is the minimum foot length in centimeters (or inches) used to filter possible wrong acquisitions.

5.4.1.6 SCREEN

The OptoJump Next software works on most desktop PCs and notebooks of the most recent generation, usually with a resolution of 1024x768 (the minimum recommended resolution). For users who want to use computers with lower resolutions (e.g., netbooks which often have 1024x600) or computers with lower performance, we recommend that you select the **'Reduced' Screen** option; this will apply the following changes:

- In the tables with numerical data and the data lists, a smaller font is used in order to fit as much information as possible in the allotted space.
- In the Test|Execute module, the webcam, though connected, is not displayed in real-time during acquisition. In any case, the video is saved and can be played in the module 'Results'.
- In the module Results|View or Compare Test it is not possible to view charts and the table with numerical data simultaneously (either one or the other). Furthermore, the bar display is disabled. In the configuration panel, the VCR Player control for the video is hidden.

5.4.1.7 NEWS & EVENTS

As described in chap. 3, when the software is launched, a series of news and events are displayed on the homepage, which are updated in real-time via the website www.optojump.com. If the computer is not connected to the Internet, the detection of missing connectivity may take a few seconds. For PCs that are permanently disconnected from the Internet (e.g. fixed stations on the training field without Internet) it is useful to disable the updating of news and events, to prevent the updating timeout.

5.4.2 OPTOJUMP (ONLY FOR NON-NEXT HARDWARE)

After having enabled the use of the software with bars of the previous model, it is possible to set the serial port for system connection and, if applicable, the serial port for connecting Racetime2 for data download.

5.4.3 OPTOJUMP HW TEST

In this section the connected hardware (OptoJump Next bars and/or webcam) can be checked. Opening the function, if the webcam(s) is (are) connected, the live image should be displayed. If one or both images do not appear, check that they have been selected in the Basic Configurations | Video or the drivers have been installed correctly.

To check the connection with OptoJump bars, press <Execute> to start the test. The test continues until <STOP> is pressed.

If there are no interrupted LEDs, the test ends with a positive result.

The test can now be repeated by pressing <Execute> and interrupting the LEDs manually, (e.g., by placing your foot between the bars). Please note that some LEDs turn red indicating interruption of the signal caused by entry of the foot. If <End> is pressed, the software will show the interrupted LEDs in the table below, indicating that the test has not had a positive result because of this intentional interruption.

This test is also very useful to check (mainly in case of outdoor installations of long bar combinations) if there are obstacles, like leaves, stones, hills, etc. between the transmitting and the receiving bar. If the obstacles cannot be removed, it is possible to exclude them via the software: all interruptions of those LEDs will not be taken into consideration for the test. The picture below shows, for example, LED no. 66-68 of bar #1, which has been interrupted with the request to exclude it from acquisition.

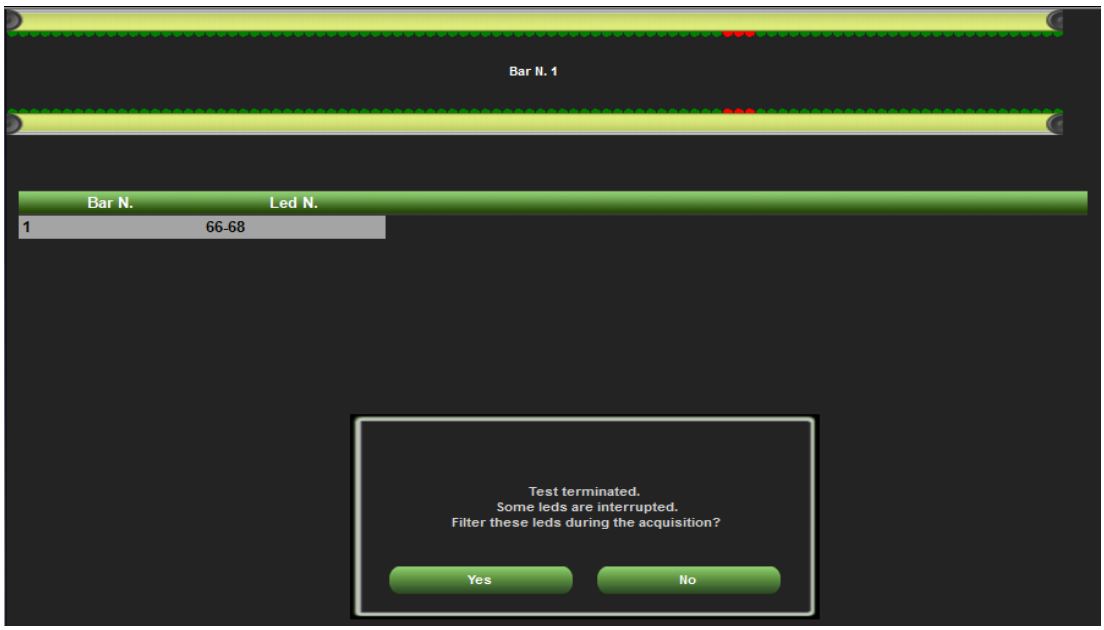


Figure 92 - Excluding an interrupted LED

If you reply YES, next time when using this function , the excluded LED will be BLUE and the button in the lower right corner, <Active LED filter>, will indicate that one or more LEDs have been excluded from the acquisition (the same button appears every time a new test is performed). Pressing the button, the filter can be removed and all LEDs of this bar can be taken into consideration again.

5.4.4 DATABASE

OptoJump Next stores all data (athletes, tests, results, settings, etc.) in a database file (Sql Server CE format with the extension .SDF). Most users can use a single file to store all information, which by default will be called 'OptojumpNext.sdf', located in the following directory:

Documents\Microgate\OptoJump Next

The name of this directory changes depending on the operating system used and the language. Some examples follow (*<YourUserName>* is the user name for logging into Windows):

Windows XP in Italian: C:\Documents and Settings*<YourUserName>*\Documenti\Microgate\OptoJump Next
Windows XP in English: C:\Documents and Settings*<YourUserName>*\My Documents\Microgate\OptoJump Next
Windows VISTA/7: C:\Users*<YourUserName>*\Documents\Microgate\OptoJump Next
etc.

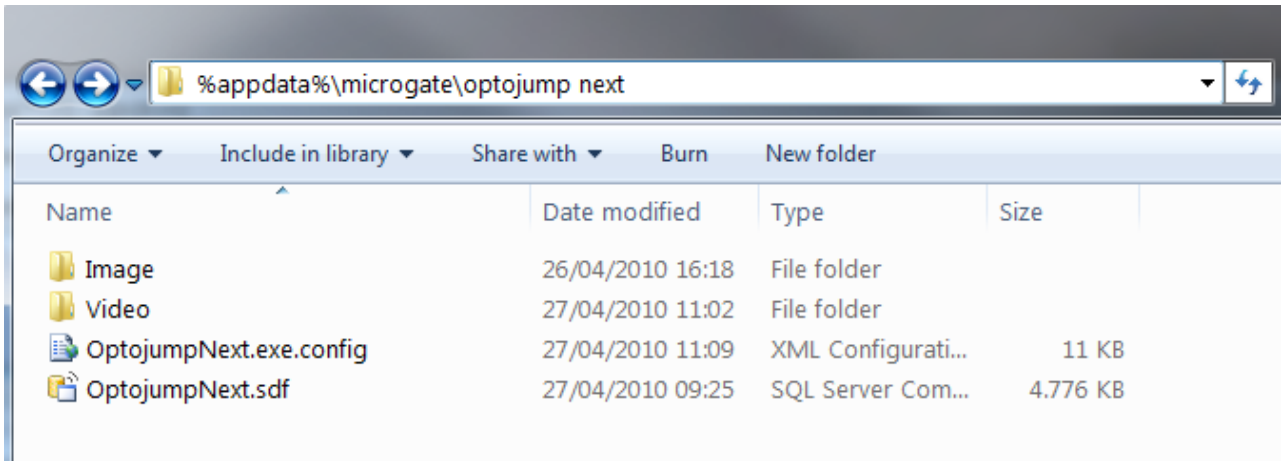


Figure 93 - Folder where by default all database, settings, video, and image files are located

The subdirectory VIDEO contains the videos (in .asf or .avi format depending on your choice in 5.4.1.4) acquired by the webcam. The subdirectory IMAGE stores all still pictures (.bmp files with possible graphical notes) saved from the module Video Analysis.

The name of the videos is formed using the following pattern:

VideoX_DD_MM_YYYY_HH_MM_SS_ZZZZZZZZ-ZZZZ-ZZZZ-ZZZZ-ZZZZZZZZZZZZ.EEE

Where

- X: webcam No. 1 or No. 2
- DD_MM_YYYY: day, month and year of acquisition
- HH_MM_SS: hour, minutes and seconds of acquisition
- ZZZZZZZZ-ZZZZ-ZZZZ-ZZZZ-ZZZZZZZZZZZZ series of univocal characters to avoid duplicates
- EEE: video format (ASF or AVI)

Example:

Video1_02_04_2009_12_32_16_1f74d384-4a7f-4c5b-a94c-1772fb608736.asf

Meaning:

Video taken by webcam No. 1 on 2/4/2009 at 12:32:16 in ASF format

The **images** (analyzed still frames) saved using the command 'Save images in report' are located in the subdirectory Image and have the following similar format:

VideoX_DD_MM_YYYY_HH_MM_SS_ZZZZZZZZ-ZZZZ-ZZZZ-ZZZZ-ZZZZZZZZZZZZ.EEE

If there is an error when loading the database, OptoJump Next notifies it at program startup, suggesting to look for the database or to continue. In the latter case, OptoJump Next creates a new empty database.

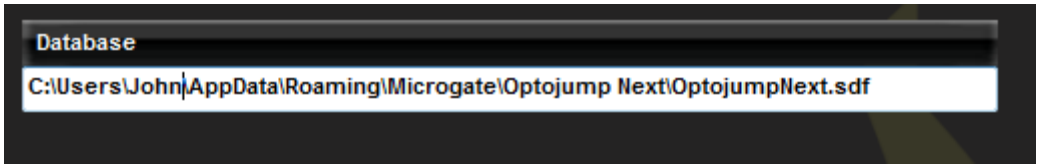
The software makes it possible to handle more databases (one at a time) for particular needs: for example, the trainer of a team, who wants to separate the tests of one season from those of another one (warning: in this case he will not be able to do any comparisons or analyze the history), or a free-lance professional, who does tests for various customers, can create a database for every team to be tested.

It is also possible to export database data in a compact format (one single file containing database, videos, and images) to transfer them from one PC to another or to hand them to the customer to review them with the software that can be downloaded for free from the website www.optojump.com.

The commands used for these purposes are the following:

5.4.4.1 Current Database

The path indicates which database is used; the commands below, <New> and <Select>, allows you to edit the directory and the file to use.



5.4.4.2 New

Creates an EMPTY database and sets it as current; you will be asked in which folder you want to place it.

When you create a new empty database (or when you import an .ojn file in a new empty database) the destination folder must be specified.

To organize the still images of a database it is useful to create an empty subdirectory (folder) for the database.

Example:

Create a folder called *MyTests* on your hard disk (in the root directory or under Documents\Microgate\OptojumpNext).

Then create a folder for each new (empty) database inside this folder. Now each database will be stored in a separate folder with its video and image files.

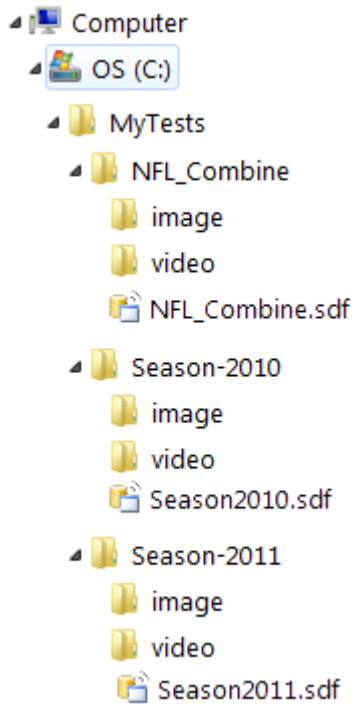


Figure 94 - Database organization example

5.4.4.3 SELECT

If more than one database has been created, you can choose (browsing on the hard disk) which one to be the ACTIVE one.

5.4.4.4 CLEAR

Empties the current database of all Athletes, Groups, Test Definitions, and Tests (tests, protocols, analyses) data. You will be asked which of the four tables to empty and further confirm (this operation is IRREVERSIBLE).

5.4.4.5 IMPORT PREVIOUS

Allows you to import the database of the previous HW/SW version. You will be asked to locate the .opj file saved with the old software.

5.4.4.6 EXPORT

Exports the CURRENT database together with all videos and still pictures processed in a single compressed file with the extension .OJN; you will be asked in which directory (or on which drive, for example a USB stick with sufficient space) to create and store the file and how to name it. It is possible to export only the database, without videos and images, choosing 'Database (*.sdf)' from the File Type dropdown menu.

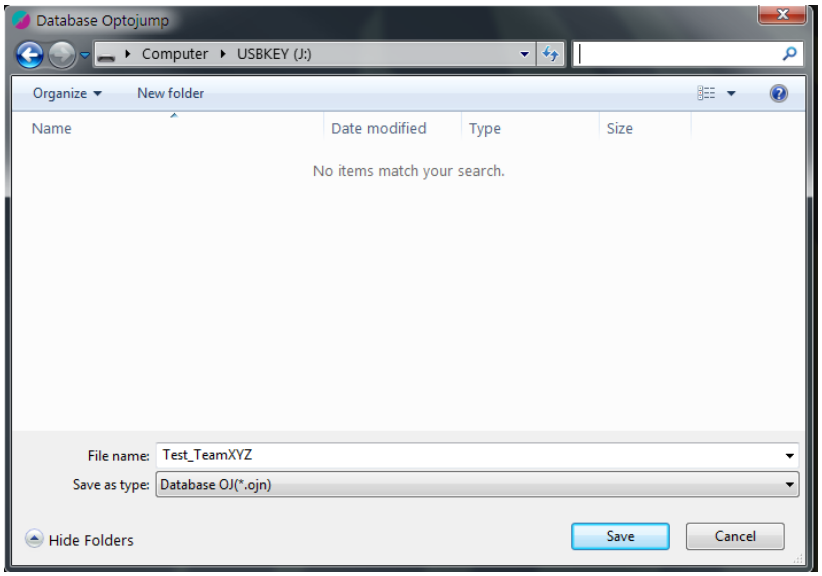


Figure 95 - Saving the OJN file

5.4.4.7 IMPORT

Imports an .OJN file previously exported to another PC or to the same PC, in case of data deletion or removal (restore). This command can also be used to merge two databases into one database.

This operation is carried out in THREE steps:

- You will be asked if you want to import into a new database (Import) or the current one (Merge)
- The first dialog box asks you locate the file with the extension .OJN to import
- The second dialog box (only if you clicked YES in the first message window) asks in which folder to extract the .ojn file and as a consequence to store the database file (.sdf) and its subdirectories Video and Images. It is recommended to use the suggested default destination directory, which is the local Documents folder.

Example: You want to import an .ojn export file saved on a USB stick extracting its files to the folder 'C:\My OptoJump Test':

Press <Import>, browse to the drive of the USB stick (in the following example J:) and select the file Test_TeamXYZ.OJN double clicking on it:

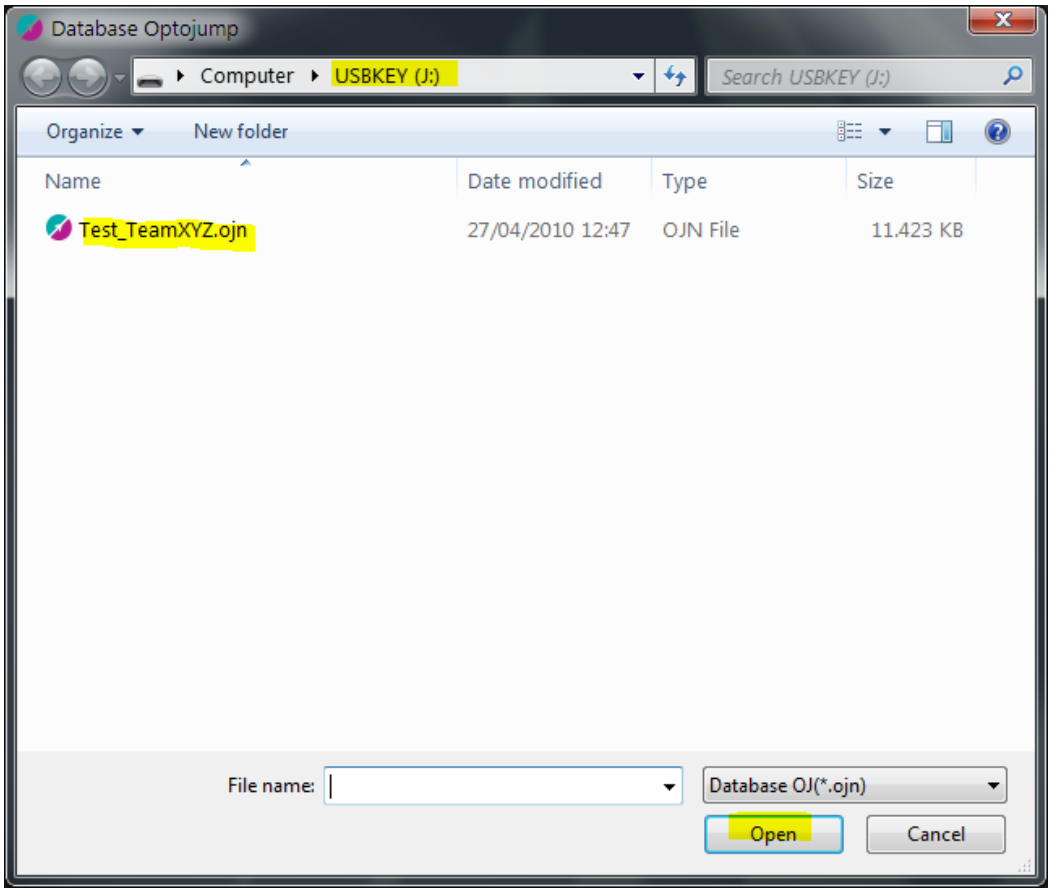
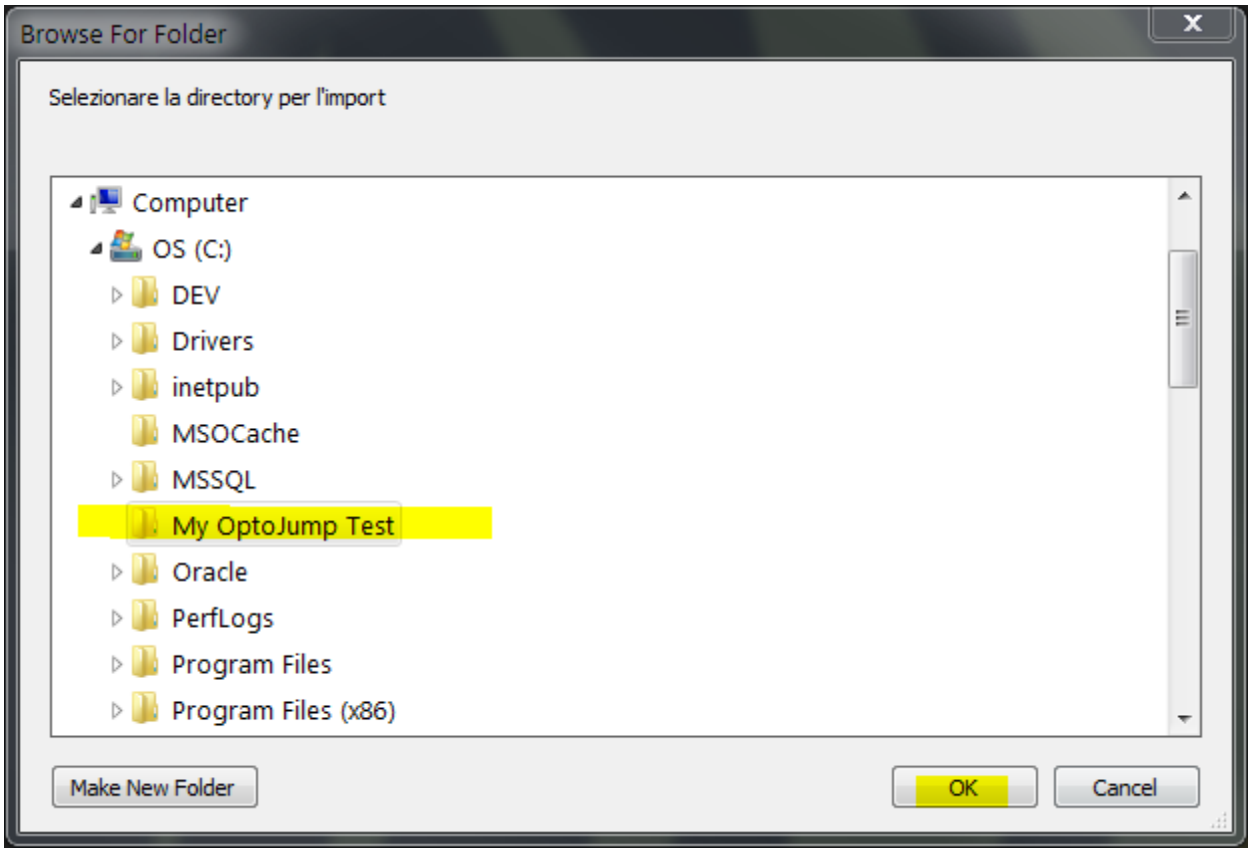
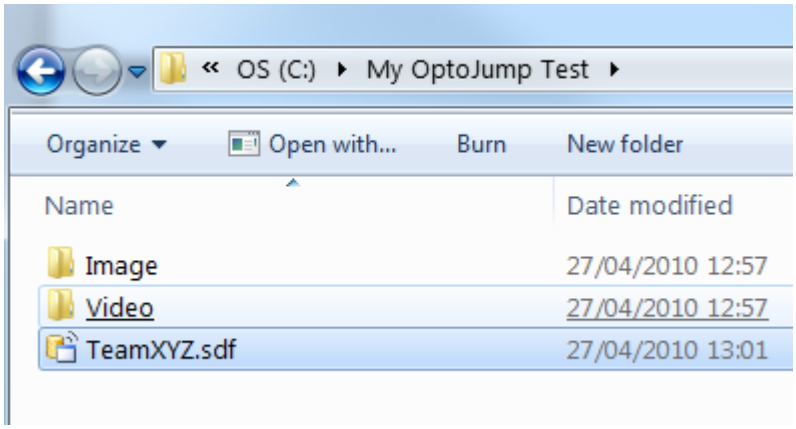


Figure 96 - Choosing the OJN file to import

Now choose the directory for the import; if not present, create it using <Make New Folder>.



The selected folder will contain the extracted files.



The database is automatically set as current, as you can see in the relevant field:

5.4.4.8 SAVE AS

This command allows you to DUPLICATE the CURRENT database. This can be useful for backups or to have a copy of the database in which to keep the data of Athletes and Groups, but where you do not want test data (e.g. when beginning a new season). You will be asked in which directory to store the file and to name it. ATTENTION: Unlike the command Export Database(*.sdf), 'Save as' saves the sdf file *and* also the videos and still images.

5.4.5 CHECK UPDATE

This checks if the installed version is the most recent one. If not, OptoJump Next suggests that you download the newest version from the site.

NB: before pressing <Check Update> check that the Internet connection is active.

5.4.6 ABOUT

This section displays respectively:

- Hardware and software characteristics of the computer
- Version of the OptoJump Next software and of video component
- Version of the OptoJump Next bars, LED definition (10 mm or 30 mm) and system structure (number of bars in X and Y)

If our Support Team asks you to provide this data, select the whole field with the cursor, right-click on it and select COPY. Then send an e-mail in which you PASTE the copied data.

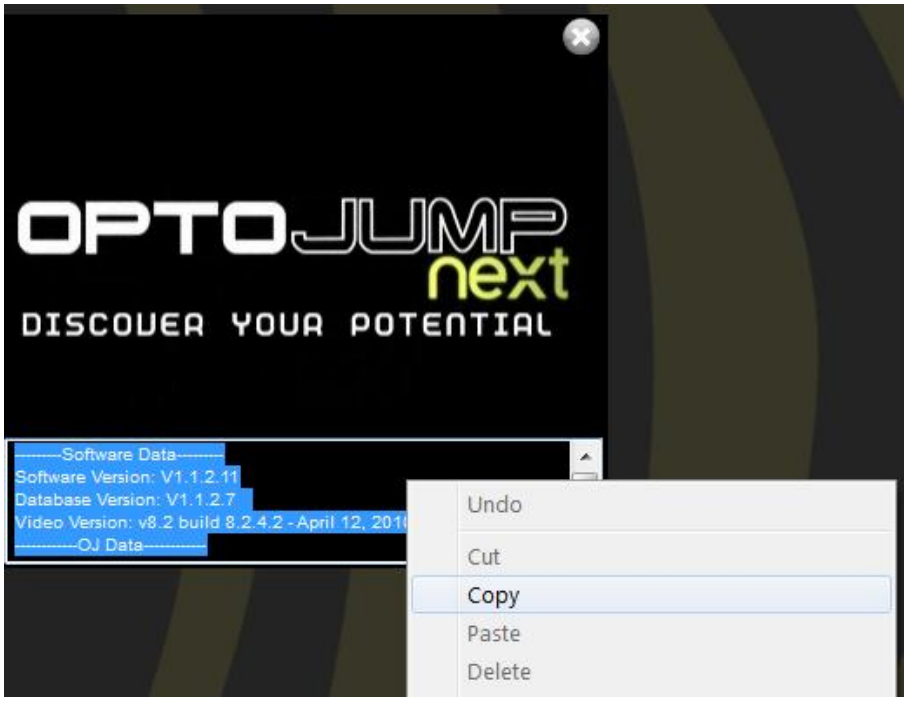


Figure 97 - About window showing the technical data for the Support Department

6 OPERATING PRINCIPLES

6.1 DEFINITION OF RESULT COLUMNS

6.1.1 GENERAL INFORMATION

- **Column #**: contains information on the various row types. The following values are possible
  - **External**: row with a time generated by an external or end of test signal with a timeout or end of time
  - **1,2,….no. (progressive number)**: valid row. Each row represents a jump and can contain a contact + flight/step time or only flight/step time
  - **Averages**: average values for the various columns. The average is not calculated for all columns; it is calculated using only the times of valid rows (indicated with a progressive number)
  - **Std**: standard deviation of the column compared to the average; the standard deviation is not calculated for all columns
  - **Interrupted**: if a test is interrupted prematurely by the user, the test finishes with this warning message
  - **Error**: in a reaction test, if single repetition fails this is signaled with Error
  - **Deleted**: row with contact and/or flight/step times deleted from displays and calculation of average and total values (see Management of invalid times for more details)
  - **Tc not valid**: row with invalid contact time; contact + flight/step times for this row are therefore added to the flight/step time of the row above (see Management of invalid times for more details)
  - **Tf not valid**: row with invalid flight time; contact and/or flight/step times for this row are therefore added to the contact time of the line below (see Management of invalid times for more details)
  - **No step**: in a running/gait test, when the number of steps acquired is lower than the number of rows with contact + flight times, excessive rows are signaled like this
  - **Suspended**: indicates that a treadmill type test was suspended for a certain time and then resumed;
  - **Split**: time passed from the Start to the reception of an external split signal, valid only for running/gait tests;

6.1.2 JUMP AND REACTION TEST

- **TCont. [s]**: Contact times
- **TFlight [s]**: Flight times
- **Height [cm or in]**: Height of jumps calculated with the following formula

$$h = \frac{T_v^2 \cdot g}{8}$$

- **Power [W/kg]**: Expressed power calculated with the following formula

$$P = g^2 \cdot T_f \cdot \frac{(T_f + T_c)}{4 \cdot T_c}$$

g=gravity acceleration, T_f = Flight Time, T_c = Contact Time

- **Rhythm [p/sec]**: Rhythm expressed in jumps (or steps) per second
- **Jumping Point [cm]**: This is the distance between the beginning of the bar (drum) and the middle support point. In the case of jumps with both feet perpendicular to the bars, it will show where the center of gravity is.
- **Jumping Point Gap [cm]**: Distance between the current Jumping Point and the previous, i.e. how much the centroid is displaced with respect to the previous jump. A value = 0 indicates the perfect repeatability of a jump (useful mainly for one-leg jumps), negative values indicate a displacement towards the drum (to the left for example), positive values indicate displacements in the opposite direction (to the right in this figure); in jumps with feet parallel to the bars indicate forward/back displacements.
- **Used area[cm]**: Difference in cm between the first and the last activated LED; indicates how much the legs are apart.

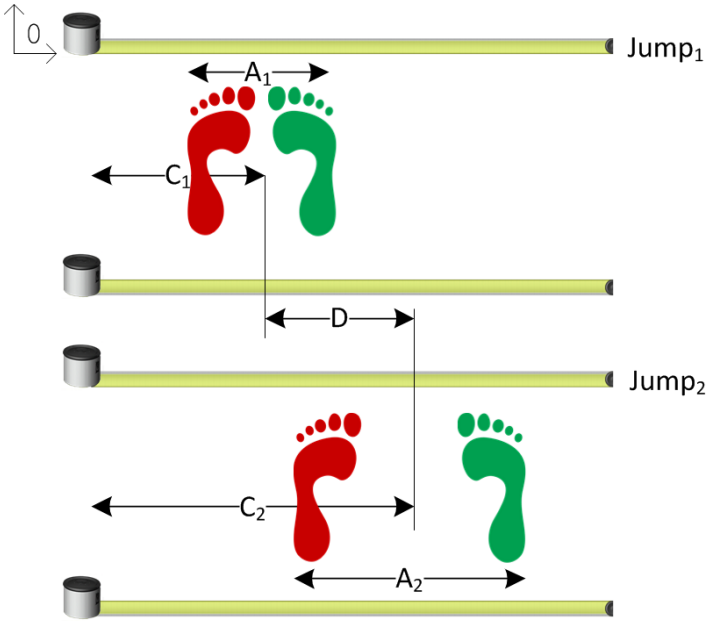


Figure 98 -Jumping Point Example (C), Jumping Point Gap (D), and Used Area (A)

6.1.3 SPRINT/GAIT TEST

The following are some useful definitions to explain the values displayed on the table with numerical data.

Step: the distance between the tip (toe) of two subsequent feet or the distance between the heel of two subsequent feet depending on the settings in the parameter 'Step length calculation' (see chap. 5.4.1.5).

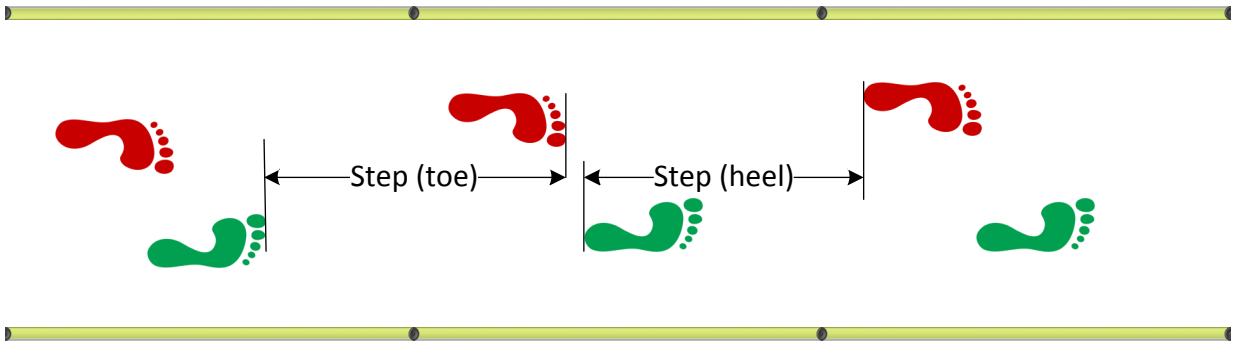


Figure 99 - Step definition

Stride: the distance between the tip of two subsequent footprints of the same foot or the distance between the heel of two subsequent footprints of the same foot depending on the settings in the parameter 'Step length calculation' (see chap. 5.4.1.5).

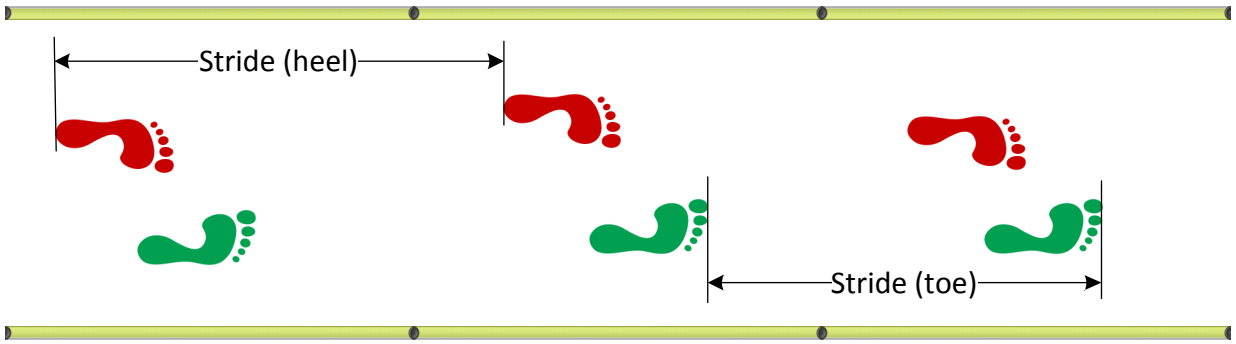
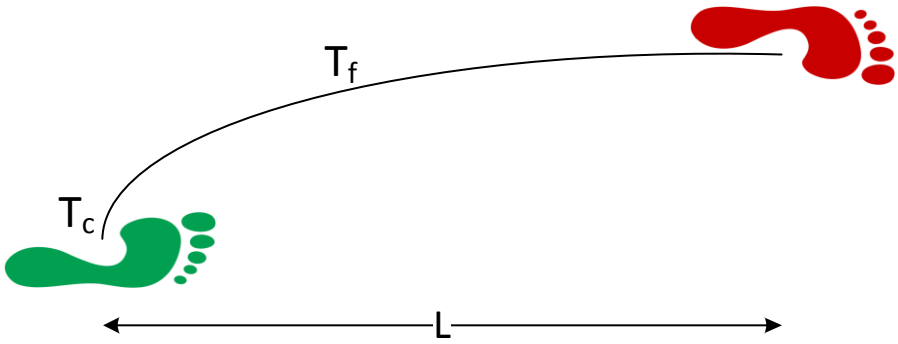


Figure 100 - Stride definition

Speed: is the relation between the distance between the two feet and the sum of the first Contact time (Tc) and the Flight time (Tf).



$$V = \frac{L}{T_c + T_f}$$

Figure 101 - Speed calculation

Acceleration: is calculated as the relation between speed delta of the two steps and the sum of the contact and flight time.

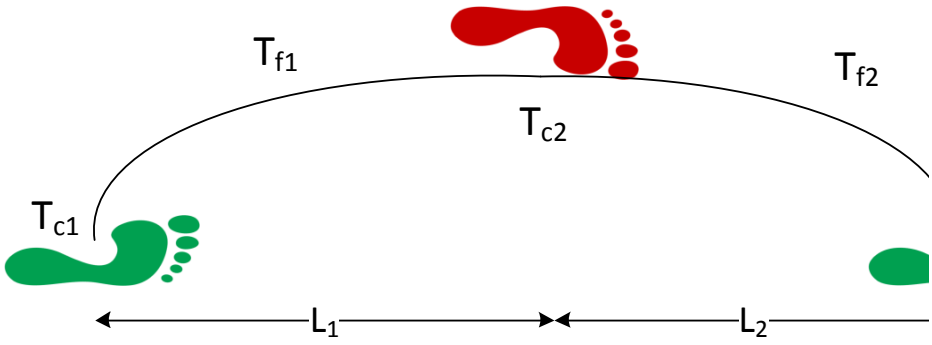


Figure 102 - Acceleration calculation

$$a = \frac{V_2 - V_1}{T_{c1} + T_{v1} + T_{c2} + T_{v2}}$$

Stride Angle: This is the angle of the parable tangent deriving from the movement of a stride (L=stride length, h=height to which the foot is risen).

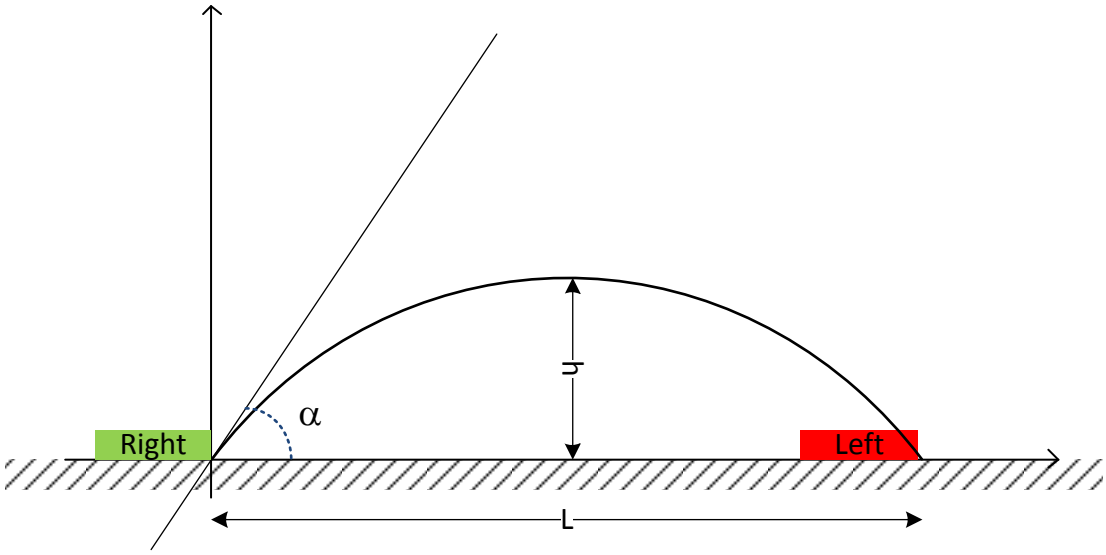


Figure 103 - Stride angle

6.1.4 REFERENCE INDEXES

In the Sprint and Gait Test parameters (chap. 5.4.1.5) the speed of an 'ideal' athlete (the so-called 'super athlete') during the 3rd, 6th, and 9th step can be indicated. These are in fact the three most interesting moments of a sprint; important studies have proven that:

- the speed of the 3rd stride is strongly related with the use of **burst power**
- the 6th-stride speed depends on the **phase of transition** between the burst power and elastic recovery
- the 9th-stride speed depends more on pure **elasticity**

Therefore the following indexes have been created and calculated as follows:

Burst index: real speed at 3rd step / ideal reference speed at 3rd step * 100

Transition index: real speed at 6th step / ideal reference speed at 6th step * 100

Elasticity index: real speed at 9th step / ideal reference speed at 9th step * 100

Example: supposing that the three speeds of reference have been set at 6, 8, and 9 m/s, the athlete's sprint is taken into consideration and his indexes are shown:

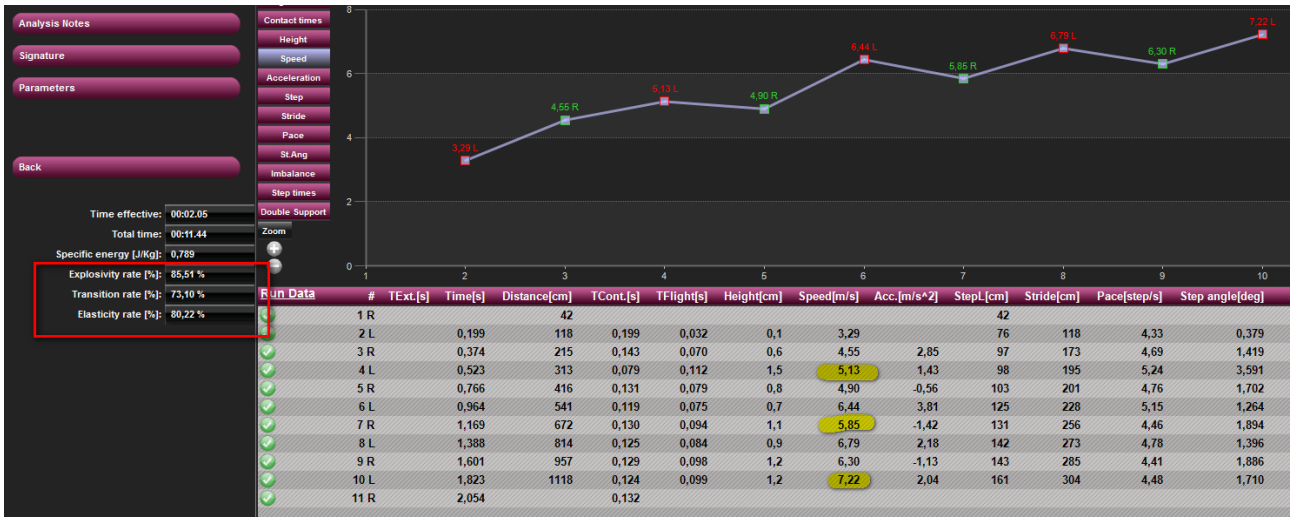


Figure 104 - The three reference indexes in the lower left part

Of course it is possible to change the three speeds of reference - as for any other secondary parameter - in any single test of a certain type or in general (see chap. 5.2.2.1).

Figure 105 - Input of 3 speeds of reference

6.1.5 IMBALANCE INDEX

The Imbalance Index column (Imb%) in sprint tests (Run Data) is an indicator of running 'asymmetry' between the right and the left.

At first a linear interpolation of two supports the same type can be assumed.

Consequently, the contact time of an ideal athlete's support would be halfway between the previous and the following; whereas in a real run there will always be a certain difference, the deviation between two times indicating asymmetry.

After having calculated the difference between ideal and real time, the relation between the difference and the ideal time (expressed in %) can be defined as **imbalance index**.

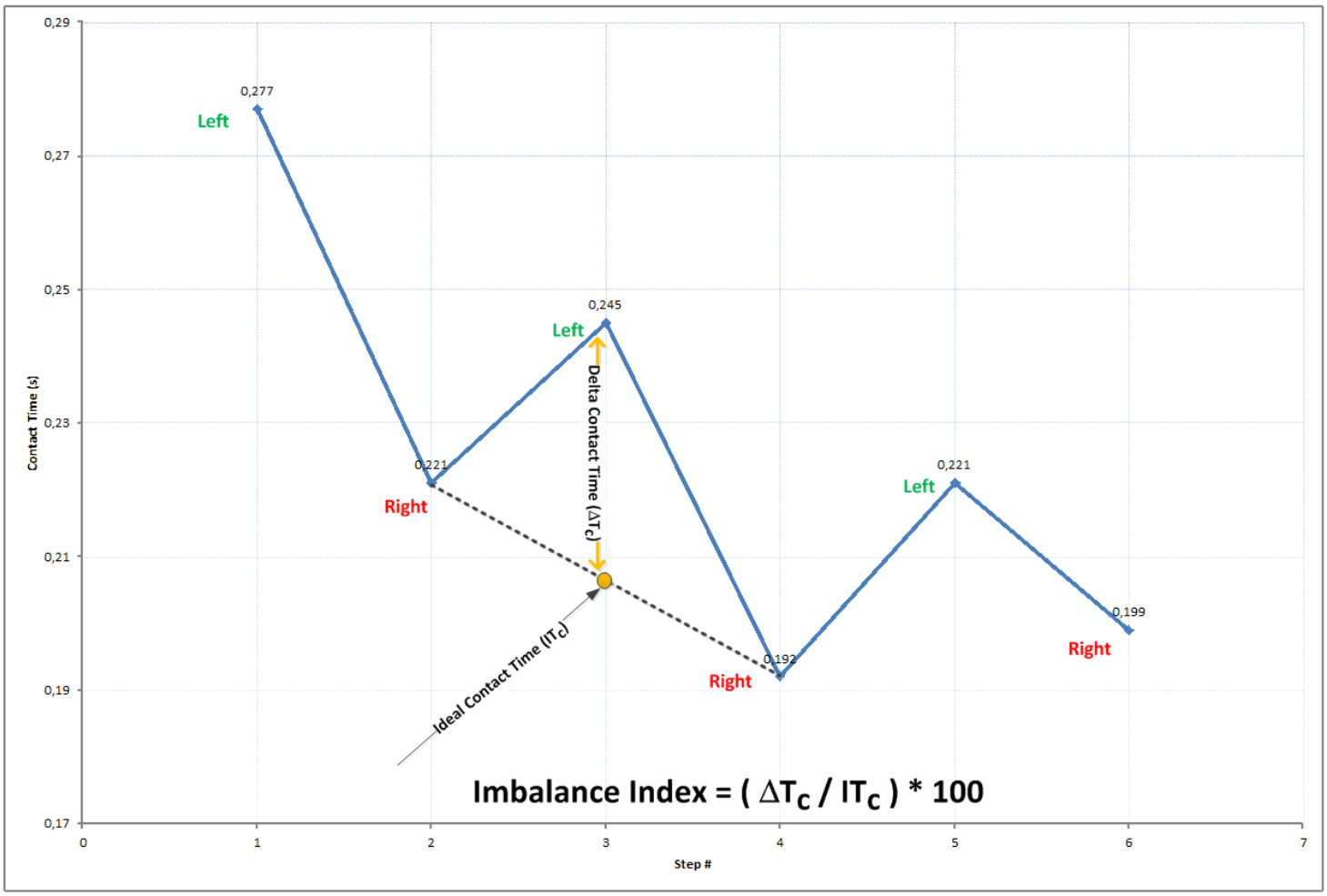


Figure 106 - Definition of imbalance index

Run Data	#	TExt.[s]	Time[s]	Distance[cm]	TCont.[s]	TFlight[s]	Height[cm]	Speed[m/s]	Acc.[m/s^2]	StepL[cm]	Stride[cm]	Pace[step/s]	Step angle[deg]	Imb.[%]	Double Sup.[s]
	1 R			42						42					
	2 L		0,199	118	0,199	0,032	0,1	3,29		76	118	4,33	0,379		
	3 R		0,374	215	0,143	0,070	0,6	4,55	2,85	97	173	4,69	1,419		
	4 L		0,523	313	0,079	0,112	1,5	5,13	1,43	98	195	5,24	3,591	2,797	
	5 R		0,766	416	0,131	0,079	0,8	4,90	-0,56	103	201	4,76	1,702		
	6 L		0,964	541	0,119	0,075	0,7	6,44	3,81	125	228	5,15	1,264	24,427	
	7 R		1,169	672	0,130	0,094	1,1	5,85	-1,42	131	256	4,46	1,894		
	8 L		1,388	814	0,125	0,084	0,9	6,79	2,18	142	273	4,78	1,396	6,154	
	9 R		1,601	957	0,129	0,098	1,2	6,30	-1,13	143	285	4,41	1,886		
	10 L		1,823	1118	0,124	0,099	1,2	7,22	2,04	161	304	4,48	1,710	3,488	
	11 R		2,054		0,132										

Figure 107 - Example of imbalance index in Run Data

6.2 GAIT ANALYSIS DEFINITION

Note: The names of these measurements are used in English in other locales, because the English terms are standard technical Gait Analysis terminology. Terms such as Single Support, Double Support, Stance, Swing, etc. are well known among professionals; therefore these terms are not translated in any language.

The following are some useful definitions to explain the values displayed on the table with numerical data:

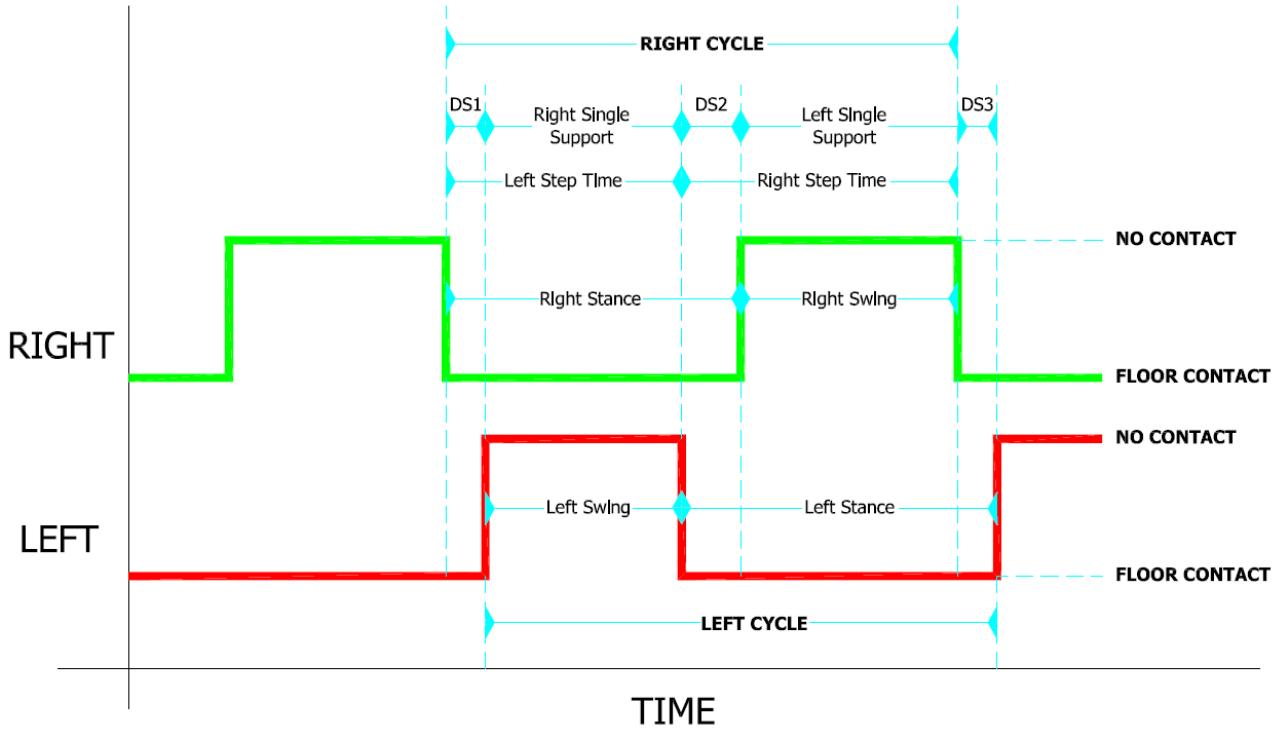


Figure 108 - Gait analysis terminology

The **Gait Cycle** begins when the heel of one foot touches the ground and ends when the same foot, after having executed one step, is set down. The cycle begins with the **Stance** phase (the heel-to-toe contact sequence of the foot) and continues with a **Swing** phase, where the foot is suspended and proceeds in the air (on average the stance phase accounts for 60% and the swing phase for 40%).

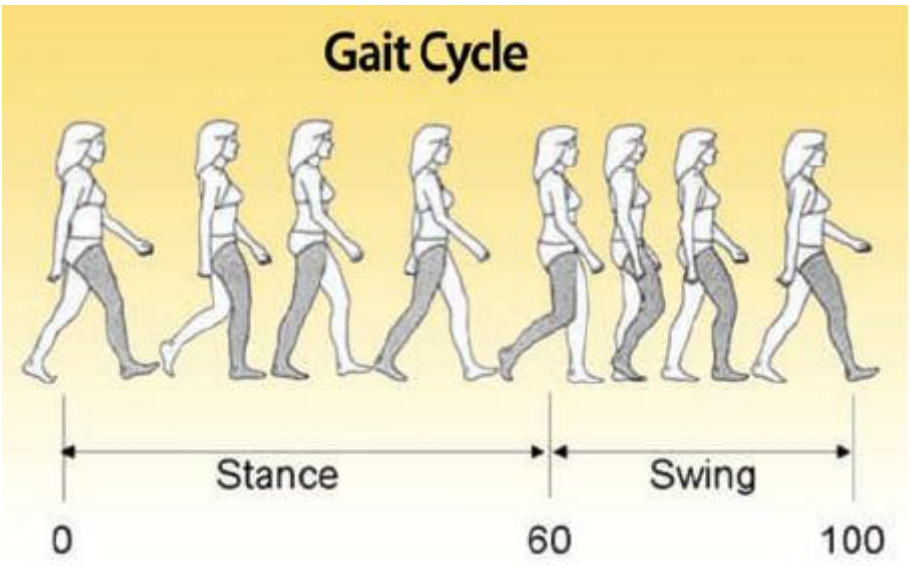


Figure 109 - Gait Cycle: Stance & Swing

Each gait cycle consists of two phases, where both feet are in contact with the ground, called **Double Support**. The first Double Support (DS1 in Figure 108 **- Gait analysis terminology**

referred to the right foot) is also called '**Load Response**', whereas the second (DS2) is called '**Pre Swing**'). When only one foot is in contact with the ground, this is called **Single Support.**

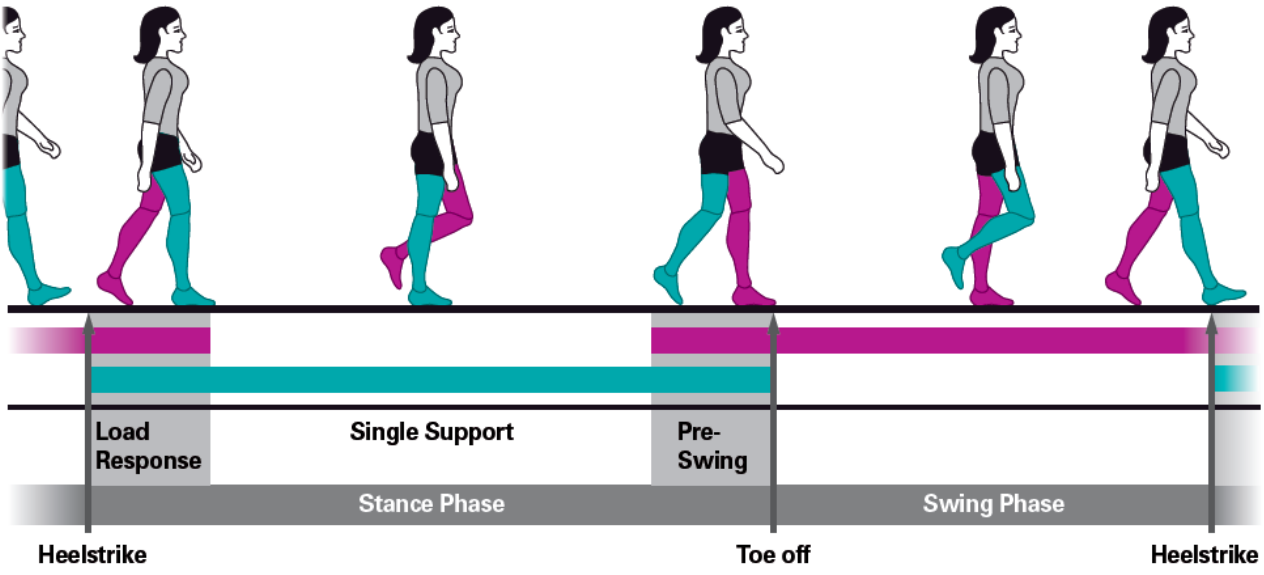


Figure 110 - Stance and Swing Phases

The definitions of **Step** and **Stride** correspond respectively to those of Step and Stride explained in the section above.

Run Data Columns

- **TExt. [s]**: External time: available only for external impulse. This is the time between the event (start/stop) of the impulse and the entry/exit into/from the OptoJump bars; it can also comprise split times
- **Time [s]**: progressive time (split) from the test beginning
- **Distance [cm]**: progressive distance walked/run by an athlete
- **TCont. [s]**: Contact times
- **TFlight [s]**: Flight times
- **Height [cm or in]**: Variation of the center of gravity height during the execution of jumps/runs
- **Speed [m/s or ft/s]**: Average speed of a single step (see Fig. 78)
- **Accelerations [m/s^2 or ft/s^2]**: Speed variations of the two preceding steps
- **Steps [cm or ft]**: Step length (see definition above)
- **Stride [cm]**: Stride length (see definition above)
- **Pace [step/s]**: Rhythm expressed in steps per second
- **Stride angle [deg]**: Alpha angle of the stride parable
- **Imb. [%]**: imbalance indices of the run between right and left step
- **Double Sup [s.]** : Double Support: Period of time when both feet touch the ground
- **Step Times [s]:** time between the first contact of one foot and the first contact of the opposite foot
- **Contact Phase [s | %]:** the time between the first contact of the heel and the complete support of the foot; the percentage indicates the value with respect to the total contact time
- **Foot Flat [s | %]:** the time the foot completely touches the ground; the percentage indicates the value with respect to the total contact time
- **Propulsive phase [s | %]:** the time between the lifting of the heel to the complete set off of the tip of the foot; the percentage indicates the value with respect to the total contact time

Gait Data Columns

- **TExt. [s]**: External time: available only for external impulse. This is the time between the event (start/stop) of the impulse and the entry/exit into/from the OptoJump bars; it can also comprise split times.
- **Stance phase [s | %]**: The stance phase is the weight phase supporting phase of each gait cycle. It begins with the contact of the heel and finishes with the set off of the tip of the same foot. It is therefore the time between the first and the last contact of two consecutive supports of the same foot. It is also presented as a percentage of the total gait cycle.
- **Swing Phase [s | %]**: The swing phase begins when the tip of the foot leaves the ground and finishes with the contact of the heel. It is therefore the time between the last contact of the first support of the foot and the first contact of the following support. It is expressed in seconds (sec) and as a percentage of the gait cycle of the same foot. The swing time of one foot corresponds to the single support time of the other foot.
- **Single Sup.[s | %]**: Single Support: This is the time between the last contact of the current support and the first contact of the following support of the same foot (i.e., the time when only one foot touches the ground). The single support corresponds to the swing time of the opposite foot. It is expressed in seconds and as a percentage of the total gait cycle time.
- **Total Double Sup [s | %]**: This is the sum of two partial double supports, defined as DS1 and DS2 in Figure 108 - Gait analysis terminology
-
- **Step Time [s | %]**: This is the time between the first contact of a foot and the first contact of the opposite foot (it corresponds to the Step Time in the Run Data)
- **Load Response.[s | %]:** This is the first Double Support Time (DS1 in…)
- **Pre Swing. [s | %]**: This is the second Double Support Time (DS2 in…)
- **Step Length [cm]:** Step length (see definition above)
- **Gait cycle [s]**: time between the first contact of two consecutive steps of the same foot
- **Stride Length [cm]:** Stride length (see definition above)
- **Speed [m/s]:** Average speed of a single step (see fig. TODO)
- **Accel. [m/s^2]:** Speed variations of the two preceding steps
- **Cadence [step/s]:** Rhythm expressed in steps per second
- **Total dist. [cm]:** progressive distance walked/run by an athlete
- **Contact Phase [s | %]:** the time between the first contact of the heel and the complete support of the foot; the percentage indicates the value with respect to the total contact time
- **Foot Flat [s | %]:** the time the foot completely touches the ground; the percentage indicates the value with respect to the total contact time
- **Propulsive phase [s | %]:** the time between the lifting of the heel to the complete set off of the tip of the foot; the percentage indicates the value with respect to the total contact time

6.3 INVALID TIMES MANAGEMENT

There are cases, during a test, where the program may acquire invalid times. The main cases are:

- The OptoJump device is not installed correctly: if the OptoJump device is badly positioned on the ground, or the ground is particularly uneven, during performance of a test invalid flight or contact times may occur
- The athlete knocks against the device: if during the test the athlete knocks against the device without causing it to lose its alignment, this may only temporarily generate some invalid times;
- The athlete exits the measurement area: in very long tests, the athlete may exit the measurement area for one jump and then re-enter the area.

In these cases, it may be convenient to keep the test and make a manual/automatic correction to times rather than repeat the test itself.

In fact, the OptoJump program contains an automatic and manual system for managing spurious times acquired during a test. Checking for spurious times is only done on flight, step, and contact times, with any external times always considered as valid.

The basic criterion is that acquired times are always coupled with (contact time) + (flight time or step time). Flight or step times without a corresponding contact, flight or step time are only possible at the beginning or end of a test contact (because of the start or finish type set in the test).

In the case of a very brief contact, flight or step time, there is an automatic procedure that identifies any invalid times, (i.e., below a certain threshold). This threshold can be set or deactivated (see chap. 5.4.1.2)

If there are other errors that are not automatically deleted, it is possible to manually correct them. Select the row with the invalid contact, flight or step time and delete the entire row (and thus the contact-flight time couple). These values will not be considered in the calculation of average values and will not appear in the charts.

If it is the contact time that is not average, add the contact-flight time couple to the flight time of the previous contact-flight time couple. If it is the flight time that is not average, add the contact-flight time couple to the contact time of the following contact-flight time couple.

The following chart clarifies this concept:

Invalid contact time (delete contact time):

Cont. time	Flight time is	Cont. time	Flight time
0.35	0.43	0.35	0.43
0.30	0.15	0.30	0.45 (0.15+0.05+0.25)
0.05 (inval.)	0.25		
0.32	0.41	0.32	0.41

Invalid flight time (delete flight time):

Cont. time	Flight time is	Cont. time	Flight time
0.35	0.43	0.35	0.43
0.10	0.05 (inval.)		
0.15	0.42	0.30(0.10+0.05+0.15)	0.42
0.32	0.41	0.32	0.41

The command 'Show marked rows', accessible from the Row Management Menu (see chap.5.3.1.3.1) allows you to remove the deleted rows from the view (and only from the view) in order to analyze only the data of interest.

Note: if the OptoJump device is not installed correctly and consequently generates spurious times during a test, it is better for the user to correct the installation of the device to eliminate spurious times beforehand rather than to filter invalid times afterwards. Correct installation can be checked using the OptoJump bars Test (see chap. 5.4.3).

6.4 VIDEO ANALYSIS

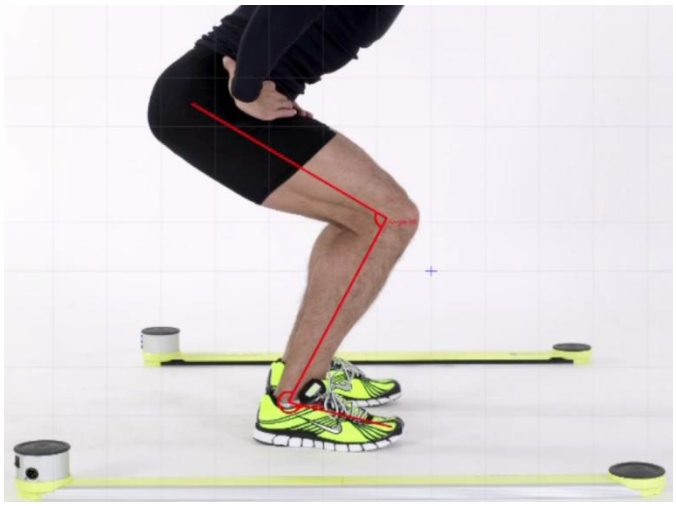


Figure 111 – Video Analysis

To analyze a still video picture, double-click with the mouse on the video window. In a Compare analysis or in a test, where two webcams are used, use CTRL+double-click to edit the two images.

Available commands are the following, from top to bottom:

- Delete all
- Load an image stored on disk
- Save the image on disk in .BMP format
- Save the image in the report; you will be asked to name the image, which will be appended at the end of the report. See chap 0
- Save the added graphical elements (grids, rows, angles, texts, etc.) as overlay in the video
- Delete the items added with the previous command as overlay of the video
- Select items. To select more than one item keep CTRL pressed
- Pan: Moves all added items
- Move: Moves the selected item
- Undo
- Redo
- Set the current color
- Set the font and other text features
- Draw a grid with the set features on the image
- Sample ruler: allows to set a known length (e.g. the height of a step)
- Add the timecode of the still frame
- Draw single line
- Draw connected lines (ESC to close the drawing)
- Draw circumference through two points

- Draw center-radius circumference
- Draw two-point arc
- Draw center-radius arc
- Draw three-point arc (Start / End / Include)
- Draw three-point arc (Start / Include / End)
- Draw lines viewing internal angle
- Draw lines viewing external angle
- Text tool
- Line with measure: draw a line with length indication calculated after having used the tool Measurement Ruler. WARNING: the measurement must be made on the same level of the item measured before (e.g., have the athlete stand sideways to a step of a known height, use the tool 'Sample Ruler' to measure the step, then measure the athlete with this tool).

To exit press the EXIT symbol at the end of the tool bar.

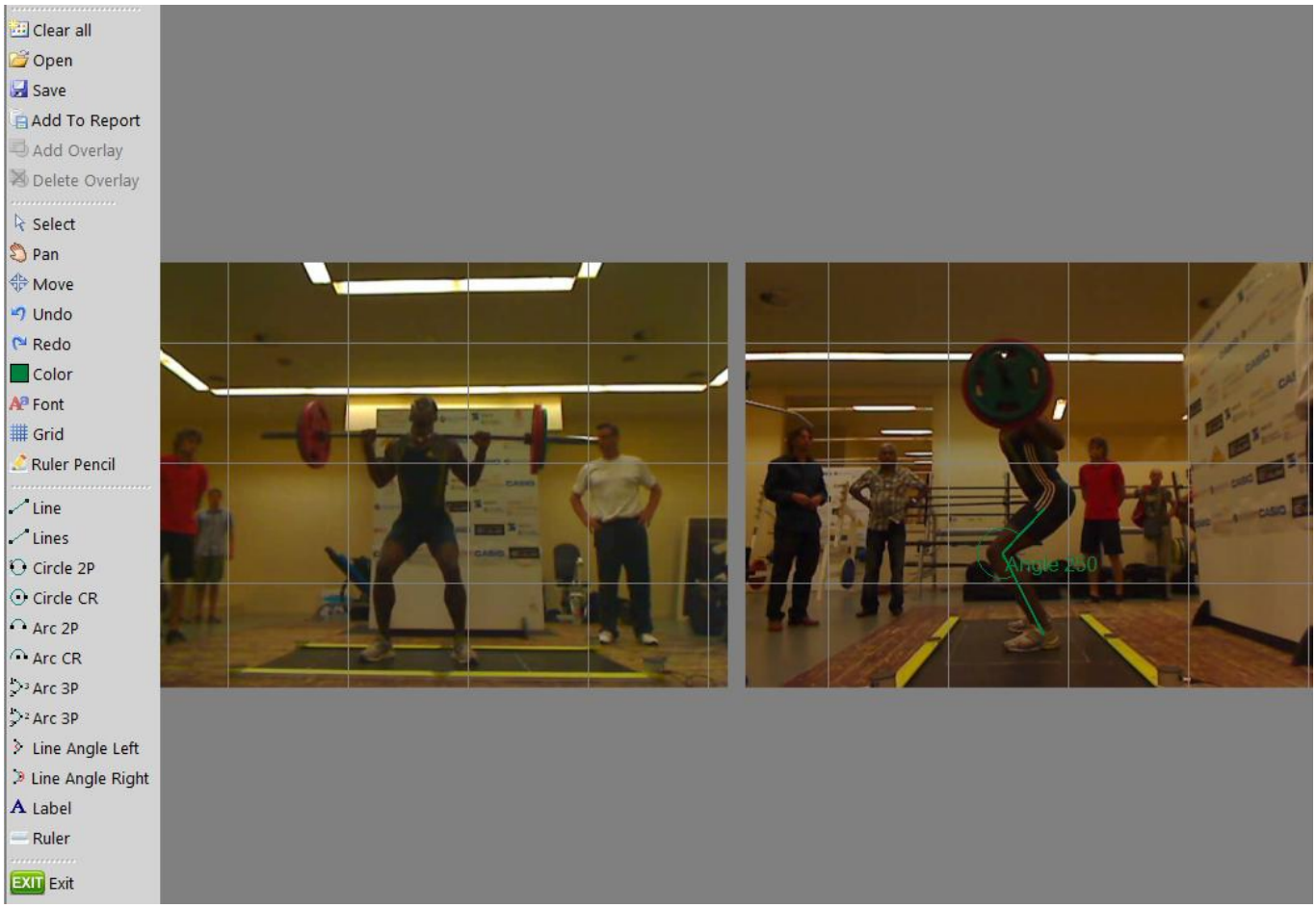
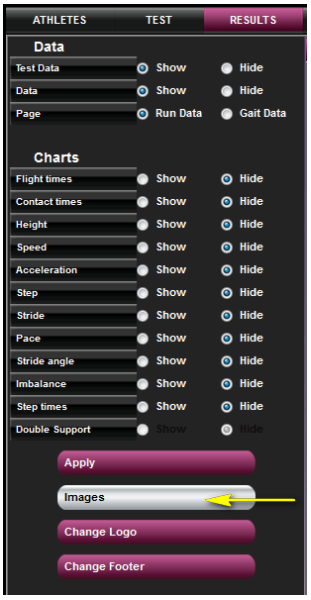


Figure 112 - Toolbar and double image under analysis

6.5 MANAGING IMAGES

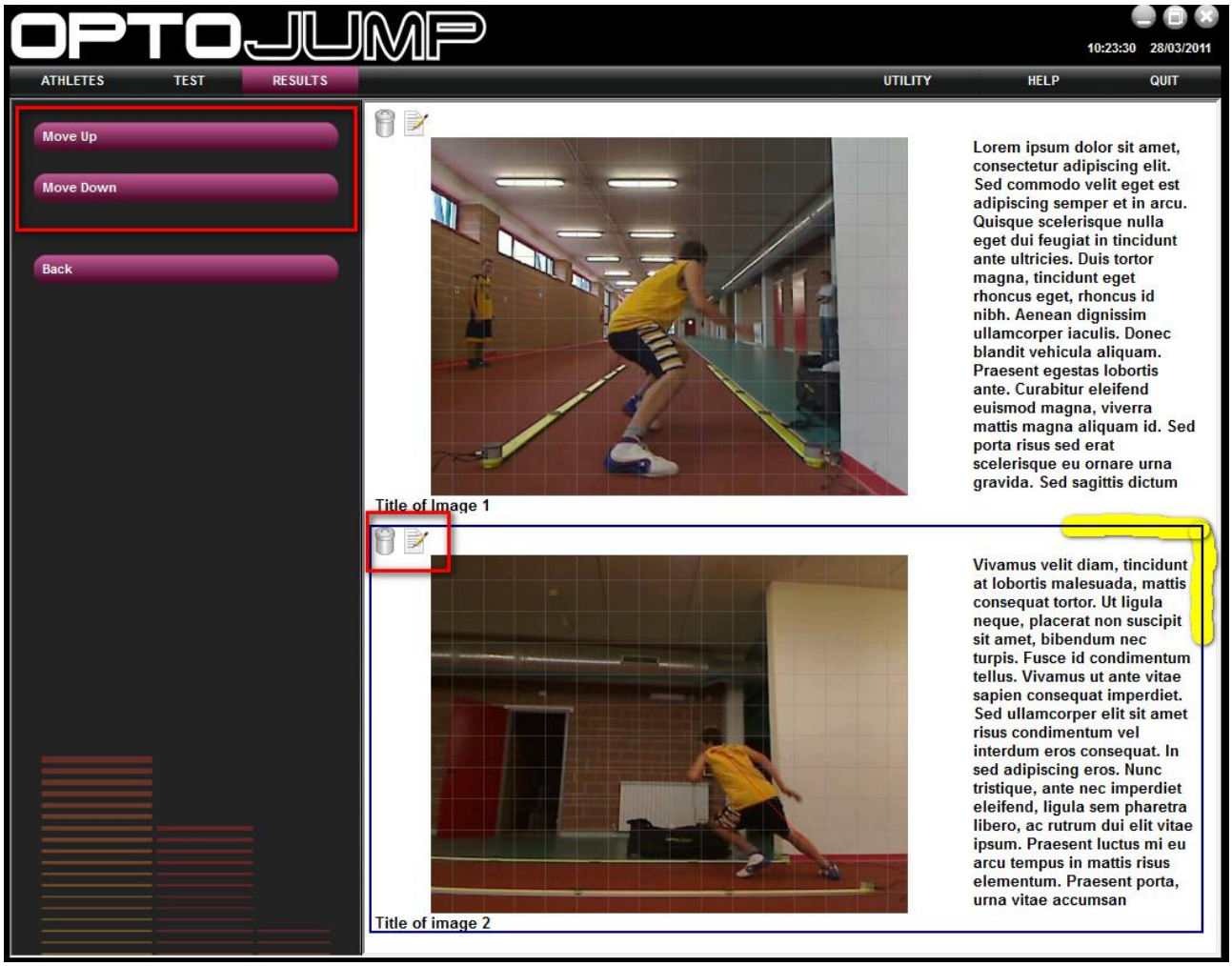


When saving an image (or two images in the case of video frames of a test comparison) it is possible to add a caption (i.e. a short name used as title) and a note (a larger field for an image description).

Images are managed (caption and note editing, changing of order of appearance and possible deletion) using the button <Images> in the Print section (chap. 5.3.1.6).

In this area there is a list of images added to the report in chronological order, each one having two icons - edit and delete - for editing captions and notes, and for deleting images from the report.

The order of appearance can be changed selecting the photo to be moved (a selected picture has a black frame) and clicking <Move up> or <Move down> in the left button bar.


OPTOJUMP
10:23:30 28/03/2011
ATHLETES
TEST
RESULTS
UTILITY
HELP
QUIT
Move Up
Move Down
Back
Title of Image 1
Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed commodo velit eget est adipiscing semper et in arcu. Quisque scelerisque nulla eget dui feugiat in tincidunt ante ultricies. Duis tortor magna, tincidunt eget rhoncus eget, rhoncus id nibh. Aenean dignissim ullamcorper iaculis. Donec blandit vehicula aliquam. Praesent egestas lobortis ante. Curabitur eleifend euismod magna, viverra mattis magna aliquam id. Sed porta risus sed erat scelerisque eu ornare urna gravida. Sed sagittis dictum
Title of image 2
Vivamus velit diam, tincidunt at lobortis malesuada, mattis consequat tortor. Ut ligula neque, placerat non suscipit sit amet, bibendum nec turpis. Fusce id condimentum tellus. Vivamus ut ante vitae sapien consequat imperdiet. Sed ullamcorper elit sit amet risus condimentum vel interdum eros consequat. In sed adipiscing eros. Nunc tristique, ante nec imperdiet eleifend, ligula sem pharetra libero, ac rutrum dui elit vitae ipsum. Praesent luctus mi eu arcu tempus in mattis risus elementum. Praesent porta, urna vitae accumsan

7 DEFAULT TESTS AND PROTOCOLS

Most tests are well-known standard tests (such as Squat Jump, Stiffness, Counter movement Jump) for which it is enough to follow the instructions on the screen (enter/exit test area, carry out a given number of jumps, wait for sound signal at the end of the test etc.).

In this section you will find default tests and protocols which might raise some doubts as regards their initial setup and execution.

7.1 DRIFT PROTOCOL

The Drift Protocol is a test developed for verifying an athlete's or a patient's 'dynamic stability' by having him/her carry out 4 tests one after another on one leg measuring his/her displacement (drift) on the vertical and horizontal axis.

Go to Test > Execute, choose an athlete and from the protocol list select 'Drift Protocol'.

In the Test field the following sequence is automatically filled-in:

- 5 jumps with RIGHT leg and feet PARALLEL to the OptoJump bars
- 5 jumps with LEFT leg and feet PARALLEL to the OptoJump bars
- 5 jumps with RIGHT leg and feet PERPENDICULAR to the OptoJump bars
- 5 jumps with LEFT leg and feet PERPENDICULAR to the OptoJump bars

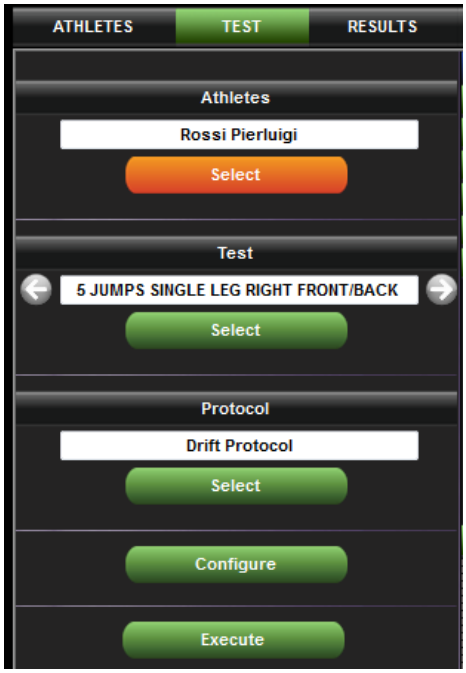


Figure 113 - Choosing a protocol

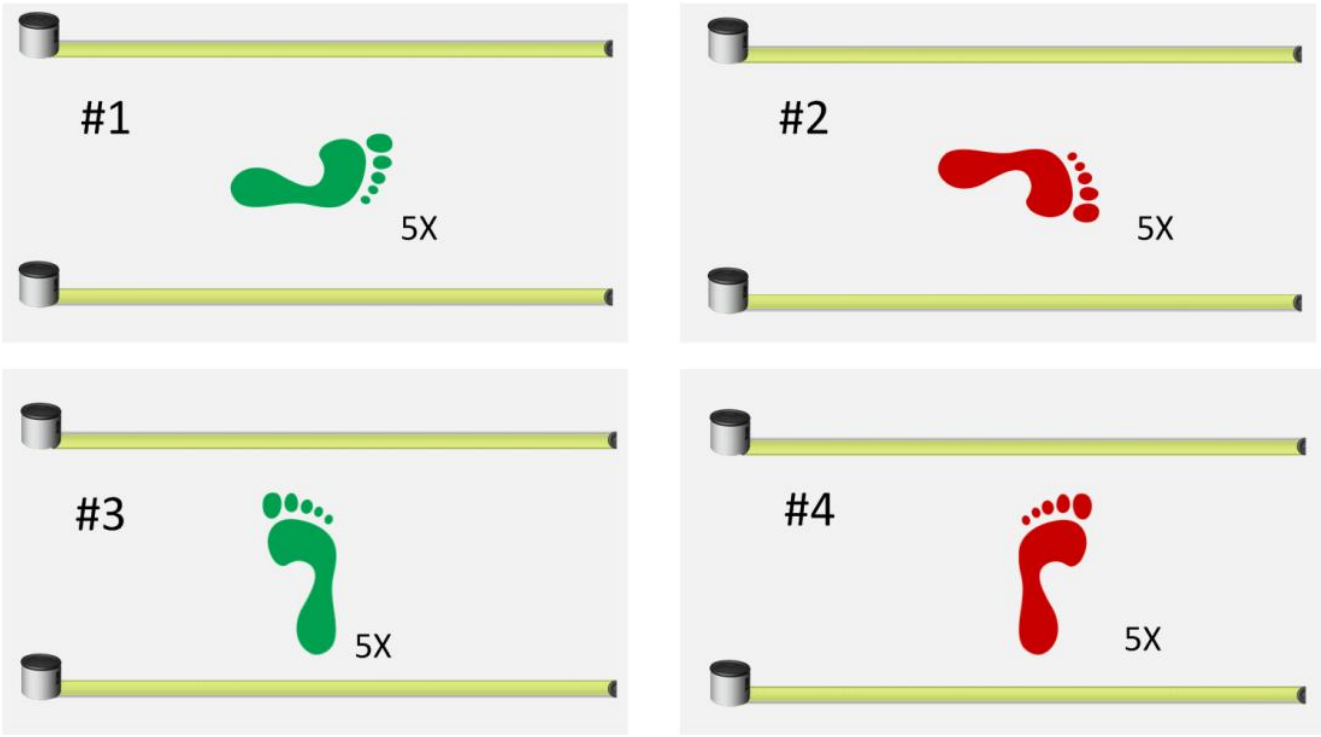


Figure 114 - Drift Protocol sequence

Carry out the 4 tests reminding to press SAVE at the end of each test before moving on to the following test.

At the end of the protocol go to Results, select the option 'Protocols' from Display>Data and choose the protocol which has just been executed, with the symbol

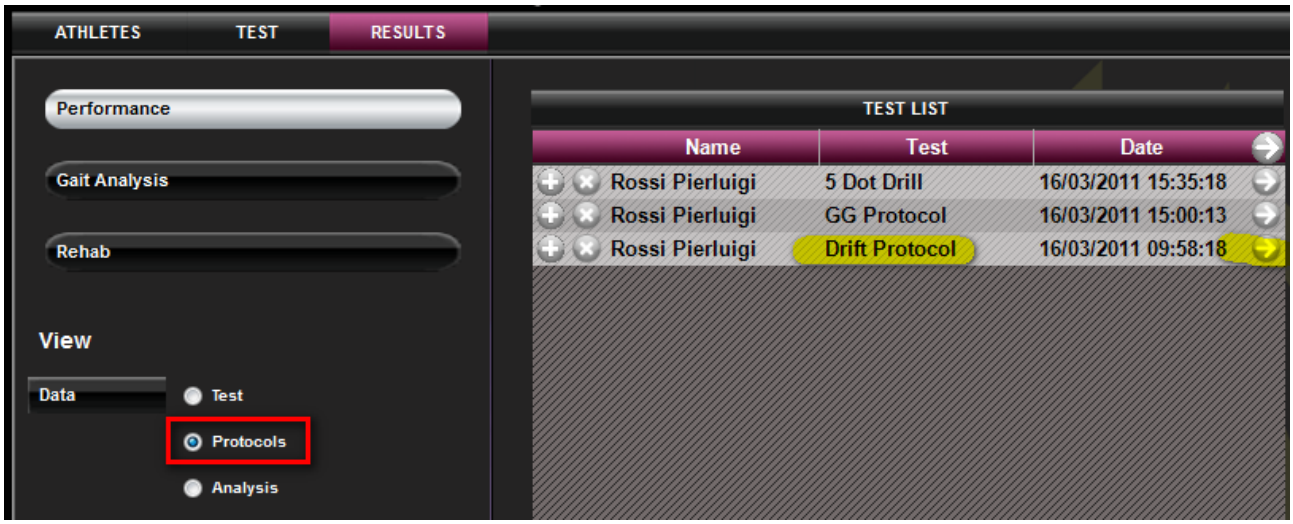


Figure 115 - Selecting a protocol to be printed

Double-click on the protocol to be analyzed (or click the button <Display>); a report will be displayed showing the average jump values divided into right and left leg and, what's even more important, two graphs allowing to quantify very rapidly the displacements and their direction.

Each jump is displayed as a yellow dot (if you can not see 10 dots per leg some might be superposed); the two large red and green dots (left and right) represent the athlete's **tendency** to move into a certain direction (e.g. upwards to the right), whereas the dotted triangle indicates the '**stability area**'.

The position of the red and green dots with reference to the origin of the two Cartesian axes gives a first indication of the athlete's ***average*** landing point compared to the starting point. As these are average data, their position could be misleading: for example, given the absurd assumption that an athlete carries out a perfectly central jump, two completely to the right and two completely to the left with two displacements of exactly the same entity, the dot will be placed exactly in the center giving the impression that the athlete always jumped perfectly.

But in this case the rectangle with the dotted area representing the **standard deviation** of jumps can be helpful. The larger the displayed area, more has the athlete drifted (moving away from the point of origin) when landing, and as a consequence his dynamic stability is lower.

Drift Protocol

	L	R	Delta%
Average Height [cm]	12,1	10,9	9,4%
Average Power[W/Kg]	11,52	10,97	4,8%
Average Contact Time [s]	0,640	0,633	1,0%
Average Flight Time[s]	0,313	0,297	5,3%
Average LEFT/RIGHT Drift[cm]	4,7	6,1	-31,0%
Average FRONT/BACK Drift[cm]	3,4	-0,6	119,1%
Standard Dev LEFT/RIGHT Drift[cm]	28,6	9,4	67,1%
Standard Dev FRONT/BACK Drift[cm]	6,3	4,7	26,0%

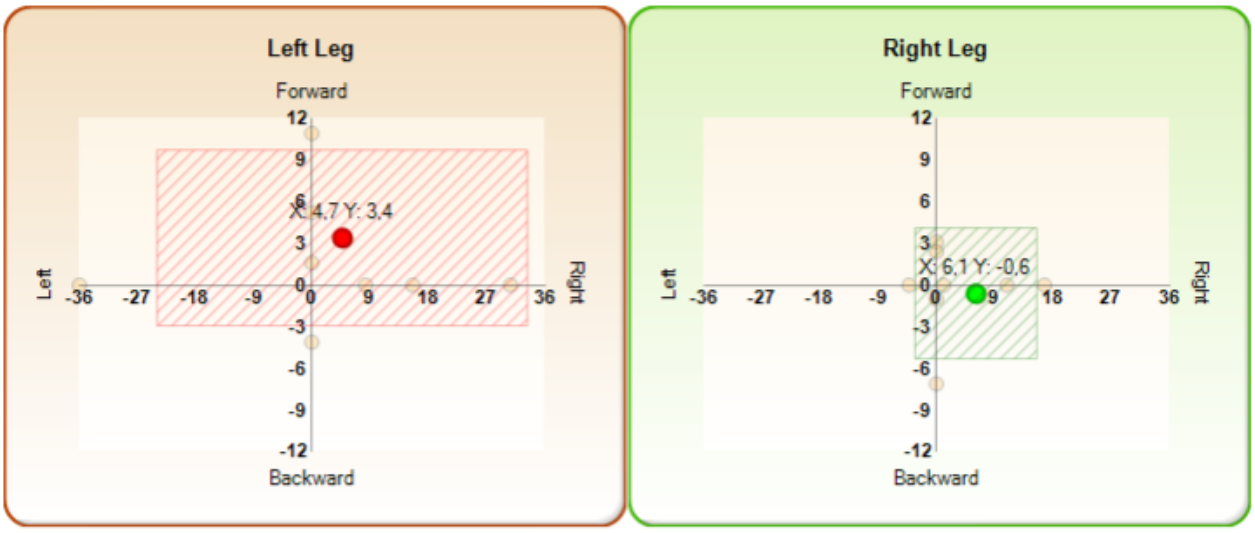


Figure 116 - Drift protocol report output

7.2 FIVE DOT DRILL PROTOCOL

The Five Dot Drill protocol (exercise with 5 circles) is a very well-known and popular test in the United States for improving ones agility and rapidity.

Draw a rectangle of 60x90 cm (2x3 ft) and place five circles of 10 cm (4”) each inside it, as shown in the picture. Alternatively you can buy a nonskid mat from the famous chain BFS Bigger Fast Stronger, developed especially for this test and contributing to its standardization.

Place the two OptoJump Next bars outside the longer side of the rectangle with the drum at the test entrance.

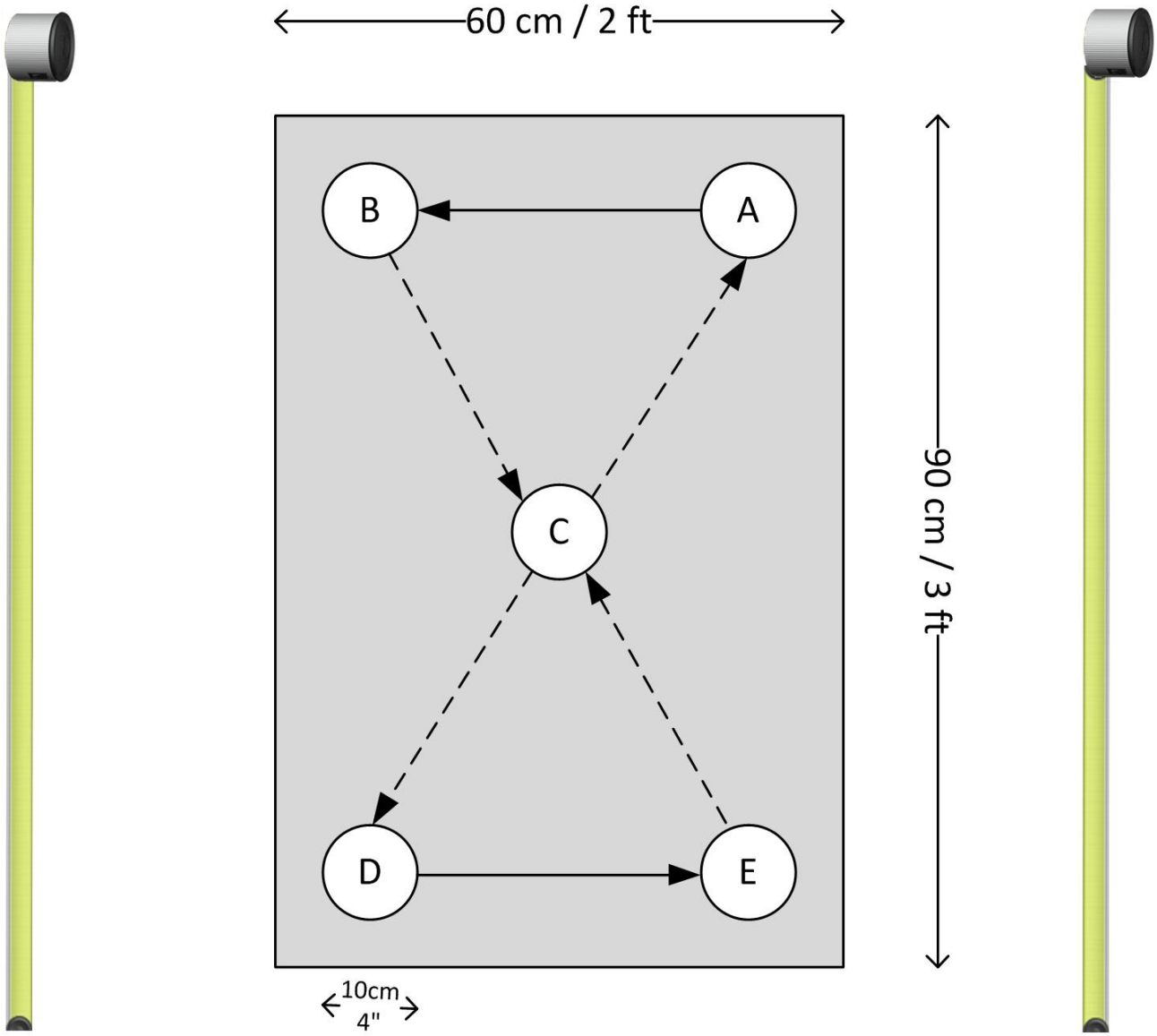


Figure 117 - 5 Dot Drill circuit and positioning of bars

The protocol is made of 5 different exercises to be carried out 6 times WITHOUT PAUSES. The main test output is the TOTAL time of all 5 exercises and this is why they must be executed as fast as possible.

The 5 tests are carried out as follows (a video explaining the exercise is available on our website):

Up & Back

1. Start with feet on A and B
2. Jump rapidly with both feet on C
3. Jump putting one foot on D and one on E
4. Jump back to the starting point
5. Repeat 5 times (6 times in total)

Right Foot

1. Your feet are now on A and B
2. Jump on C with your right foot
3. Jump with your right foot on D, E, C, A, B
4. Repeat 5 times (6 times in total)

Left Foot

1. The previous exercise ends with your right foot on B
2. Now jump on C with your left foot
3. Jump with your left foot on D, E, C, A, B
4. Repeat 5 times (6 times in total)

Both Feet

1. The previous exercise ends with your left foot on B
2. Jump with both feet on C
3. Jump with your left foot on D, E, C, A, B
4. Jump back to the starting point
5. Repeat 5 times (6 times in total)

Turn Around

1. The previous exercise ends with both feet on B
2. Jump with both feet on C
3. Jump putting one foot on D and one on E, just like in exercise #1
4. Turn around clockwise 180° (your feet will still be on E and E)
5. Jump on C with both feet and then with one on A and one on B
6. Turn again around to the left (anti-clockwise) 180° and start again
7. Repeat 5 times (6 times in total)

Even though this is a single test, it must be carried out as PROTOCOL, because this allows to have a particular print report showing the 'level' based on the following table:

DOT DRILL STANDARDS	
Less than 50 seconds	Super Quick
50-60 seconds	Great
60-70 seconds	Average
70-80 seconds	Need work
Over 80 seconds	Slow

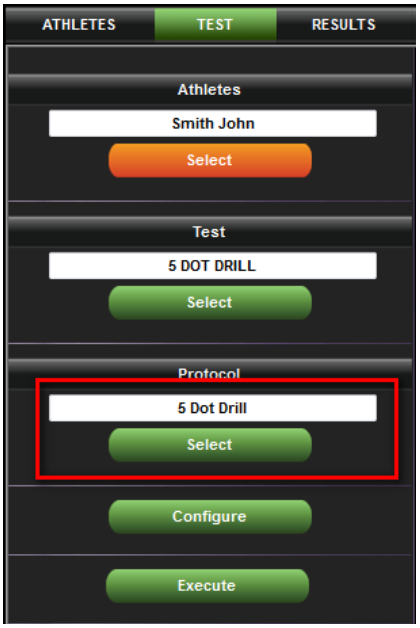


Figure 118 - 5 Dot Drill Protocol

The test ends when you stay outside the test area for more than 3 seconds.

To display the test results go to Results, select the option 'Protocols' from Display>Data and choose the protocol with the symbol and double-click or use <Display> from the Test Analysis list.

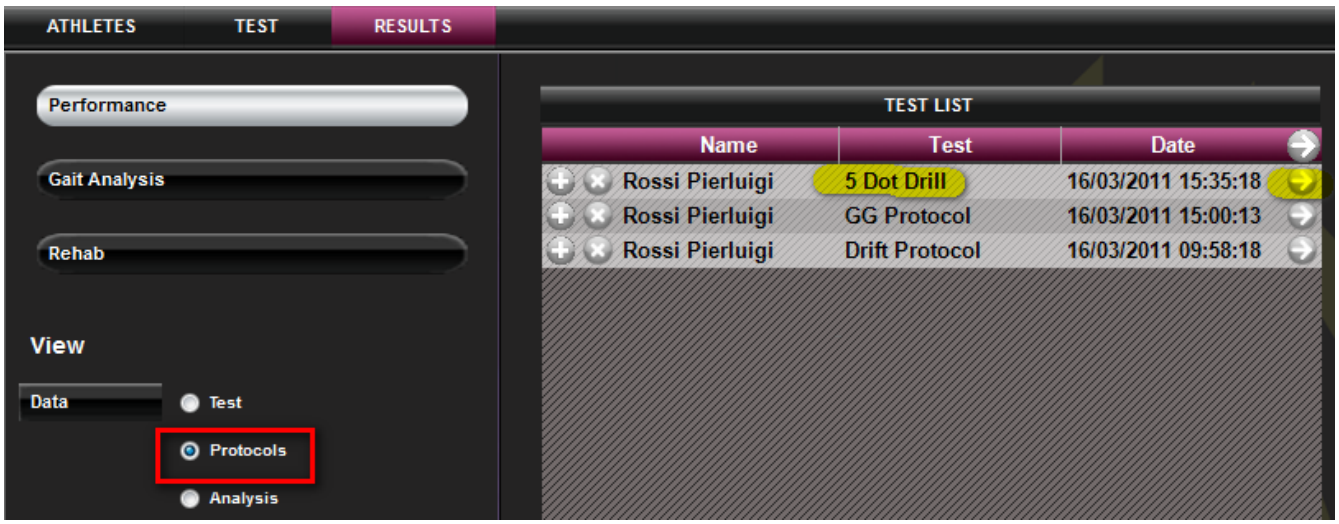


Figure 119 - Selecting a protocol to be printed

The printed report includes total time and result, as well as average flight and contact times of all 5 tests, total time deviation as percentage and fatigability index.

5 Dot Drill Protocol

Time 42.824 Super Quick

	UP AND BACK	RIGHT FOOT	LEFT FOOT	BOTH FEET	TURN AROUND	TOTAL
Time[s]	8.328	9.596	9.745	8.438	6.717	42.824
% Compared Average	-2.8%	12.0%	13.8%	-1.5%	-21.6%	8.565
Average Contact Time [s]	0.123	0.082	0.092	0.098	0.119	0.099
Average Flight Time[s]	0.237	0.186	0.161	0.141	0.140	0.170
Fatigability	-46.4%	19.6%	-18.9%	8.2%	7.1%	

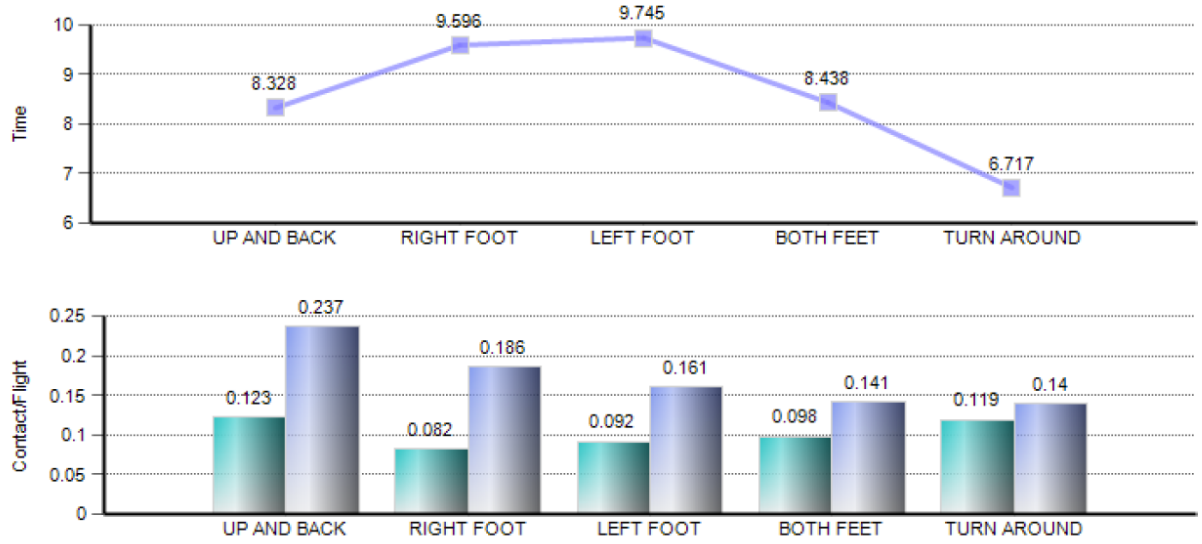


Figure 120 - 5 Dot Drill report output

The parameter '% Compared average' is calculated as difference between the average of all 5 tests and the average value of each single test.

E.g. for Up & Back: (8.328 – 8.565) / 8.328

The fatigability index is calculated using the average of the first 6 contact time values and compared to the average value of the last 6 contact times.

$$Fatigability = \frac{\text{Avg\_Last\_6\_Ct} - \text{Avg\_First\_6\_Ct}}{\text{Avg\_First\_6\_Ct}}$$

7.3 'GG' PROTOCOL

This protocol (whose name is based on the initials of its inventors) is made of the following test series with the object of an initial athlete evaluation to be used during scouting phase.

1. Treadmill Gait Test at 5 kmh (usually for 30 seconds)
2. Squat Jump with both legs (5 jumps)
3. Squat Jump with the right leg (5 jumps)
4. Squat Jump with the left leg (5 jumps)
5. Ski Test 15 seconds
6. Sound reaction test with the left leg (3 times)
7. Sound reaction test with the right leg (3 times)

At the end of the protocol a report summarizes the main test data highlighting possible asymmetry and differences between the right and left leg.

GG PROTOCOL 16/03/2011 15:00:13

Athlete Data

Athlete

Last name:	**Rossi**	**First name:**	**Pierluigi**
Birth date:	**23/02/1985**	**Gender:**	**M**
Weight:	**75**	**Height:**	**181**
Foot size:	**42**	**Notes:**	**some notes...**

Treadmill Gait Analysis at 3 mph or 5 Km/h

	L	R	Delta%
Stance[s]	0,693	0,668	3,6
Swing [s]	0,271	0,287	-5,9

SquatJump 2 legs 5 jumps

Average Power (jumps 2,3,4) [W/Kg]	19,98
Knee angle [Deg]	75

SquatJump Single Leg 5 Jumps

	L	R	Delta%
Average Power (jumps 2,3,4) [W/Kg]	10,81	11,44	5,5%
Average Height (jumps 2,3,4)[cm]	11,2	12,1	7,6%

Ski Test 15 sec

	L	R	Delta%
Average Contact Time [s]	0,552	0,554	-0,4
Average Flight Time[s]	0,118	0,106	10,2

Acoustic Reaction Single leg

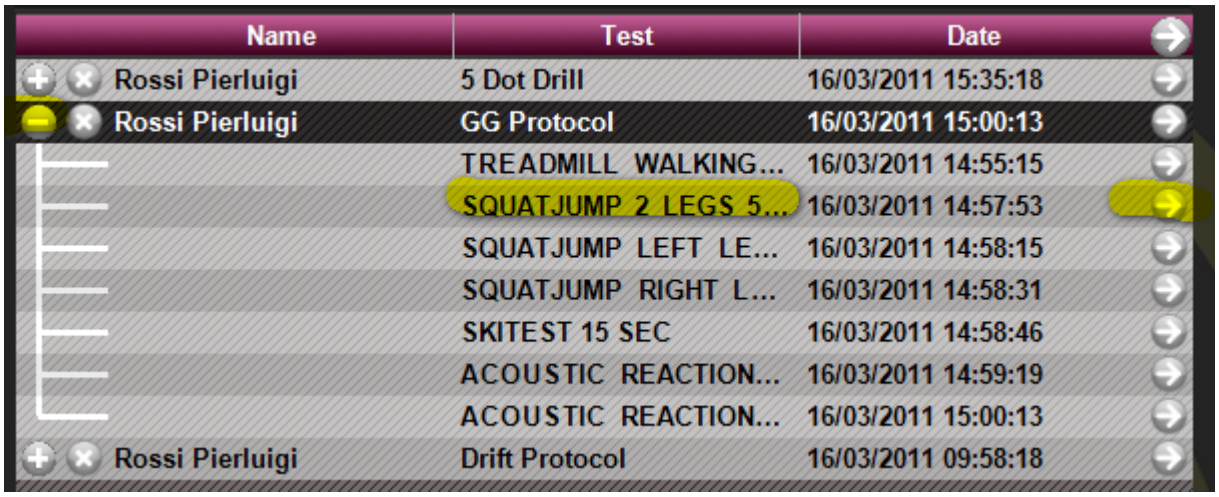
	L	R	Delta%
Average Reaction Time[s]	0,678	0,641	-5,9%

Figure 121 - Output of the Report

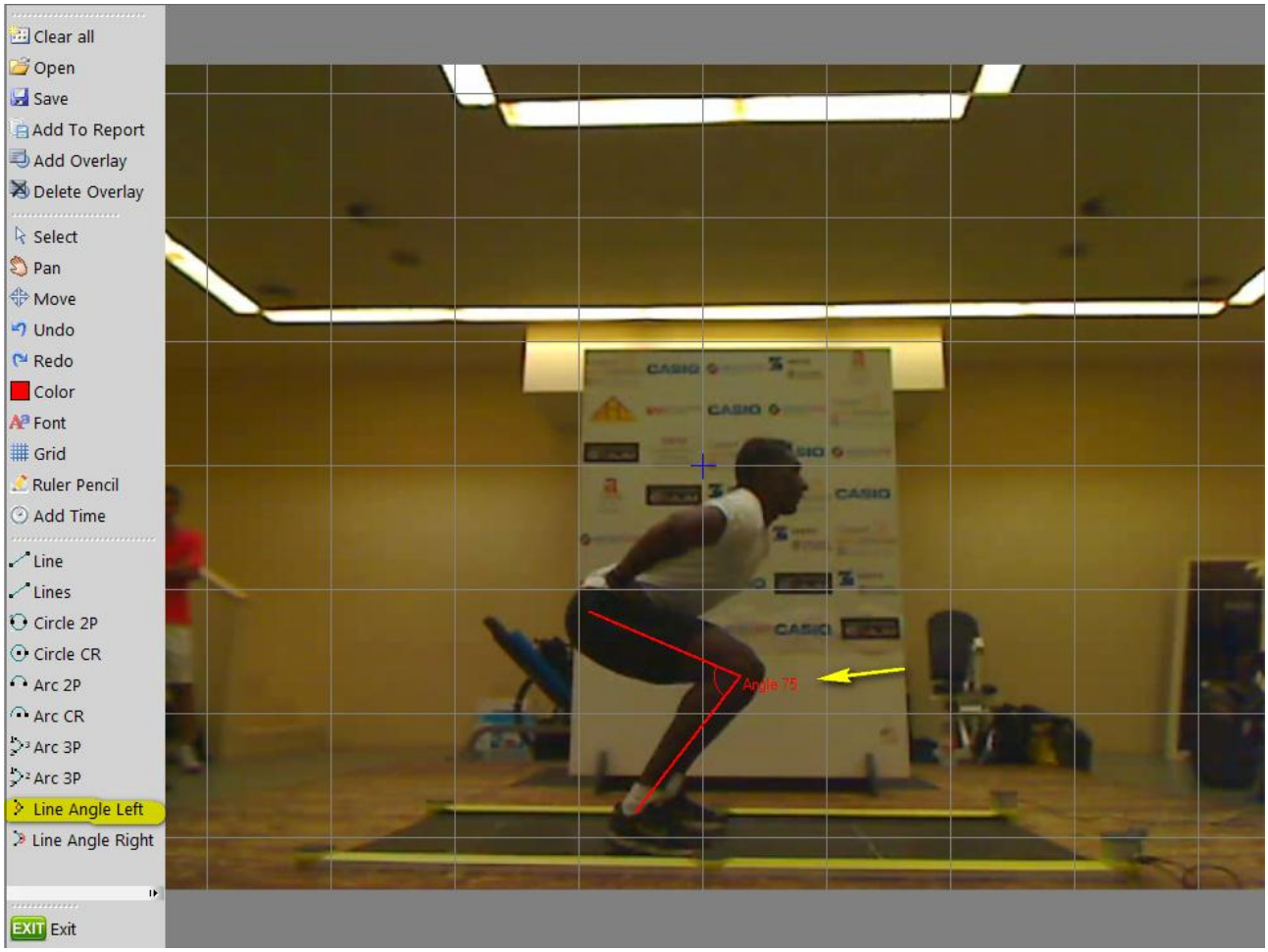
The 'Knee angle' parameter is an index which can be derived 'manually' from a video still image. Once the parameter with had been defined using the dedicated graphic tools, the value can be entered to the 'Indexes' section and will be showing in your print.

Example:

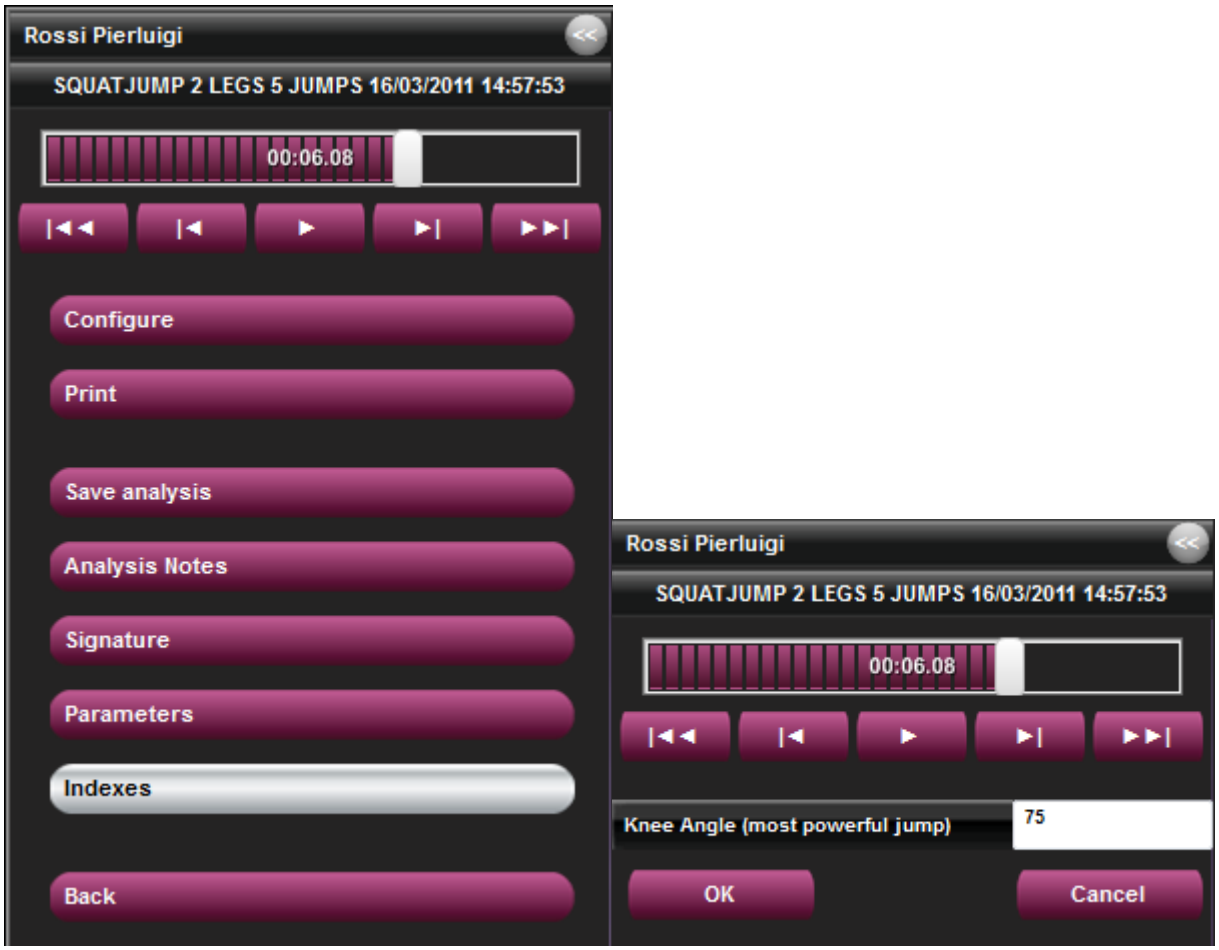
Expand the GG protocol, find the 'SquatJump 2 Legs' test and display it as a single test

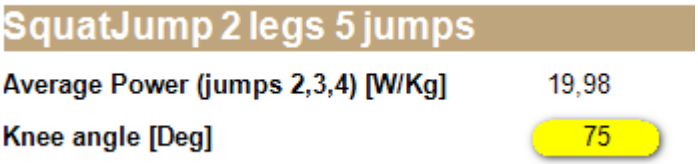


Find the desired spot in the video, double-click on the video and enter Video Analysis. With the 'Line Angle Right' tool draw two lines and read the value of the angle measure.



Press the 'Indexes' button and enter the measured value:





7.4 SINGLE LEG 3 HOPS PROTOCOL

This protocol allows evaluation of the functionality of the anterior cruciate ligament with two one-leg jumps consisting of 3 forward jumps each (possibly after post-injury rehabilitation) as regards power, as well as stabilization.

Have the athlete carry out 3 forward hops (starting slightly out of the test area on the interface drum side) first with the left leg and then with the right leg.

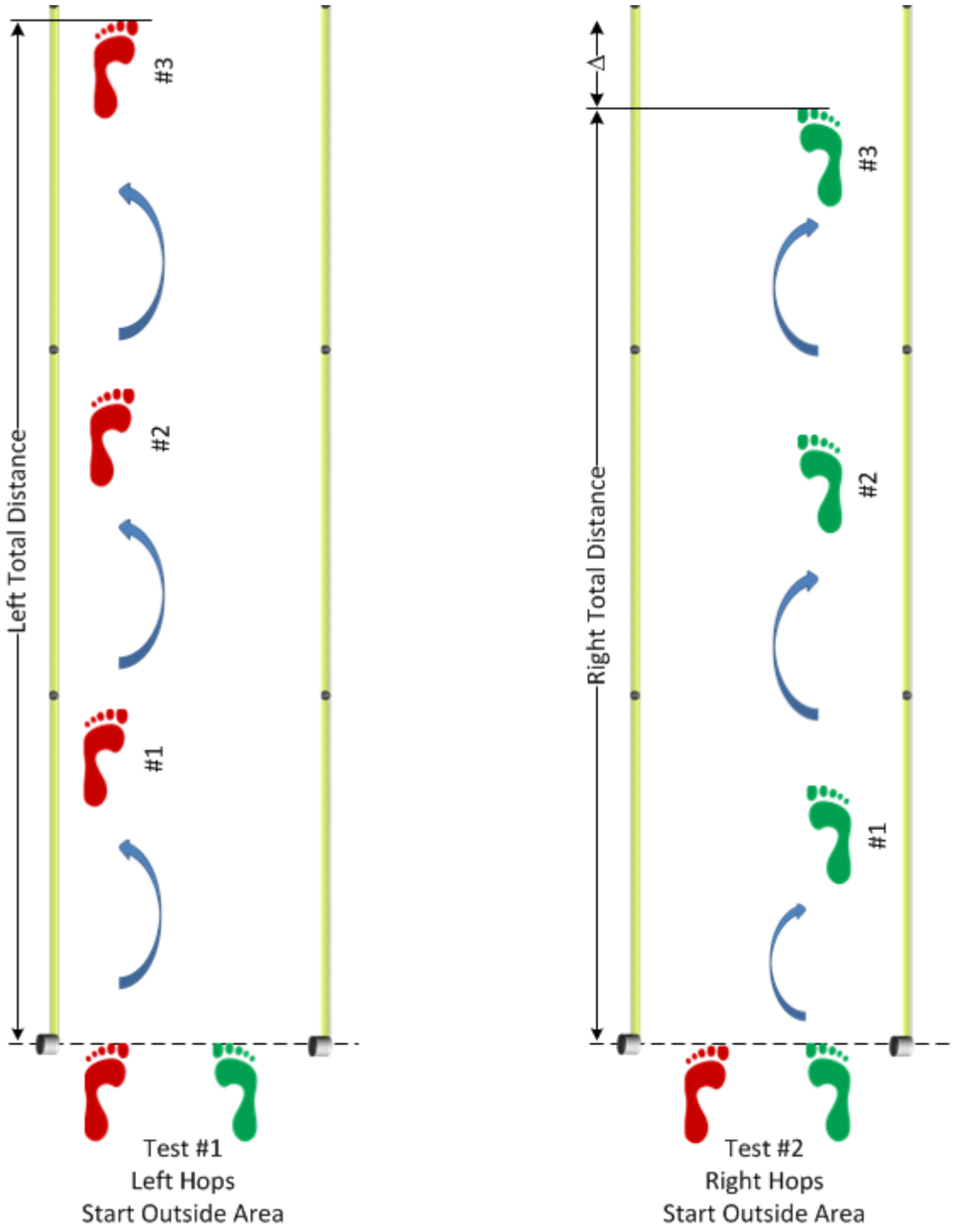


Figure 122 - Single Leg 3 Hops Protocol – Execution mode

At the end of the test, a report can be viewed under 'Results', showing the main values divided by leg and differences in %.

SINGLE LEG 3 HOPS PROTOCOL 04/08/2011 16:33:09

Athlete Data

Athlete

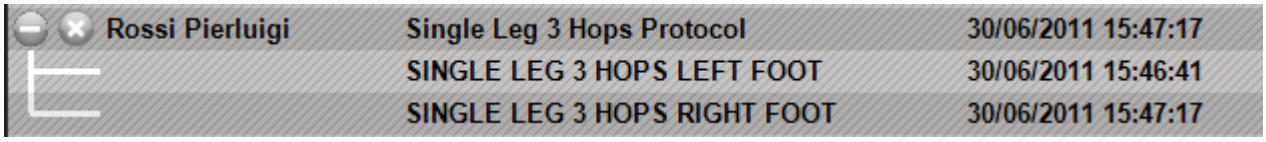
Last name:	**Rossi**	**First name:**	**Pierluigi**
Birth date:	**13/11/1977**	**Gender:**	**M**
Weight [Kg]:	**68,0**	**Height:**	**178**
Foot size:	**43**	**Sport:**	**Athletics**
Discipline:	**Long jump**		

Single Leg 3 Hops Protocol

	L	R	Delta%
Distance[cm]	346	313	9,5%
TCont.[s]	0,288	0,297	-3,1%
TFlight[s]	0,398	0,401	-0,9%
Height[cm]	19,4	19,7	-1,8%
StepL[cm]	115	104	9,5%
Speed[m/s]	1,94	1,73	10,7%
Acc.[m/s^2]	0,36	0,36	0,4%
Step angle[deg]	30,460	33,435	-9,8%
Stride[cm]	231	208	10,0%
Pace[step/s]	1,46	1,43	1,8%

Figure 123 - Report

Of course it is possible to see the details of a test by expanding the protocol and selecting 'View' in a test or 'Compare' to compare two tests.



7.5 VERTEC LIKE TEST

This test allows simulating the use of the famous VERTEC tool to analyze vertical jumps with one arm extended. A meter (or two meters for athletes jumping higher than 100 cm) can be attached to a wall with double-sided adhesive tape or mounted on a tripod with fixing clamps. It is important that the interface drums are positioned in the lower part and at the right height depending on the athlete's jump elevation. The test is not compatible with OptoJump Next bars with a resolution of 3 cm.

At the beginning of the test, the software prompts to extend one arm upwards closing the bar contacts (red led) to measure the athlete's height; it is recommended to carry out the measuring holding the hand near one of the two bars. If the test must be repeated several times (with the same bar setup) it is useful to save the measurement; of course, if the bar height changes, the measure must be changed.

Then the athlete can jump from a standing position (e.g. touching the wall with the attached bars) or with run-up through the virtual portal created by OptoJump (maybe simulating a complex athletic gesture like for example a volleyball spike).

The software displays the jump height as difference between the two measures.

Figure 124 - VERTEC LIKE test setup

Figure 125 - How to carry out a height measurement

7.6 SKI TEST

This test must be carried out with both feet parallel to the bars jumping sideways from one foot to the other (usually for 15 seconds). The main objective is to compare the contact and flight times, as well as the power of the right and left foot.

Figure 126 - Ski Test: side jumps from one foot to the other

Figure 127 - Ski Test results with separate times for right and left foot

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